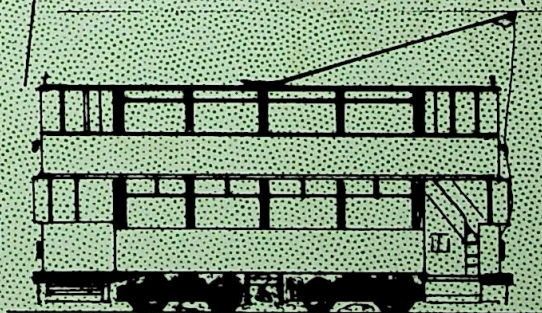
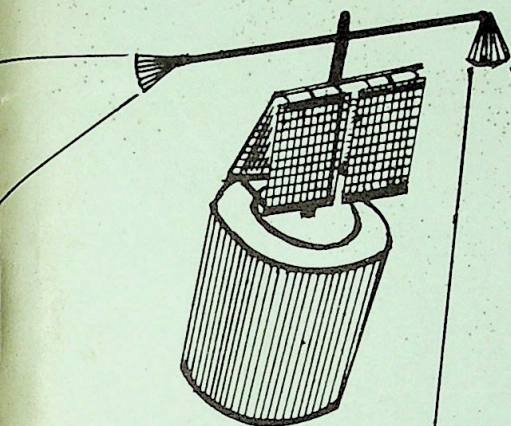


**THE CENTENARY  
OF  
ELECTRIC  
TRACTION  
1879-1979**

**THE  
BRITISH  
TRAM  
            
HISTORY'S  
ORPHAN**

**A. WINSTAN BOND**



# **THE BRITISH TRAM**



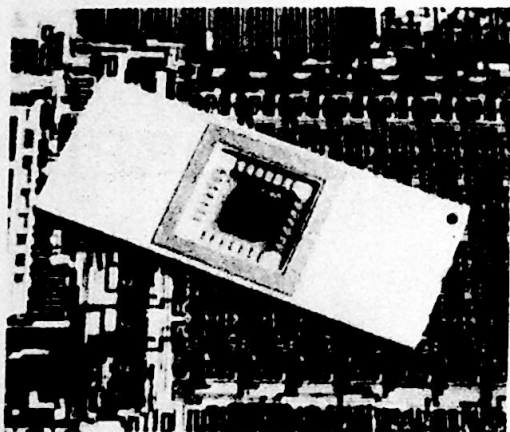
**HISTORY'S ORPHAN**



**THE CENTENARY  
OF  
ELECTRIC TRACTION  
1879~1979**

## Monolithic data-acquisition system includes RAM on chip

A monolithic data-acquisition system includes on-chip random-access memory. The AD7581 contains an 8-bit successive-approximation analog-to-digital converter, an eight-channel multiplexer, an 8-by-8-bit dual-port RAM with address latches,



## **MICRO ELECTRONICS AND THE COMING REVOLUTION IN HISTORICAL RESEARCH**

**WHAT WILL IT DO FOR THE TRAMWAY HISTORIAN?**

**THE BRITISH TRAM**  
★  
**HISTORY'S ORPHAN**

by

**A.WINSTAN BOND**



**The Walter Gratwicke  
Memorial Lecture 1979**



**THE TRAMWAY & LIGHT RAILWAY SOCIETY**

with the co-operation of

**THE TRAMWAY MUSEUM SOCIETY**

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**Lecture given at the Science Museum London in December 1979  
before an invited audience**

**© A.Winstan Bond 1980**

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the permission of the author to whom any applications should be made.**

**Produced and printed by Nemo Productions, Hartley, Kent,**

## Walter Gratwicke (1887-1967)

Walter Gratwicke was born in London and, after training as an electrical and mechanical engineer, worked for British Westinghouse, the London Underground Group and Brown Boveri. For over 40 years from 1913, he served with the British Aluminium Company in Great Britain, the United States, Australia and New Zealand, mainly in the field of power transmission. In the 1914-18 War, he saw active service on the Western Front and in the 1939-45 War, he served with the Ministry of Aircraft Production.

He was a member of the Institute of Locomotive Engineers, the Institute of Metals, the American Institute of Electrical Engineers, and the Society of Automotive Engineers.

His training, travels, clarity of mind and personal interest combined to make him the foremost tramway expert of his generation in this country, knowledge of which he unstintingly placed at the disposal of others. From 1962 until his death he was the President of the Tramway and Light Railway Society and it was to honour his memory that the Society instituted this series of Annual Lectures.



## A. Winstan Bond

Winstan Bond has been actively concerned with tramway history for over thirty years, and in the early sixties produced original articles featuring the work of little-known tramway inventors. Since then, however, his practical involvement at The National Tramway Museum, where he is Hon. Treasurer, has limited his research involvement to the organisation of seasonal exhibitions at the Museum.

Qualified as a Chartered Accountant, the author found himself naturally gravitating towards positions involving finance, international finance, and technology. After eight years as Head of Research for a firm of stockbrokers specialising in electronics, Mr. Bond has recently taken up the position of Chief Accountant at the London Chamber of Commerce and Industry. The author brings a specialised insight, flowing from his employment, into his tramway activities.

. . . . .

This restatement of the importance of the electric tramcar and the technical and social factors with which it inter-reacted was presented as the 1979 Walter Gratwicke Memorial Lecture, held at the Science Museum, London. The full lecture was developed in conjunction with the author's contribution on behalf of The Light Rail Transit Association to the Centenary of Electric Traction lectures, sponsored by the Institution of Electrical Engineers. The main theme will form the basis for a permanent exhibition at The National Tramway Museum at Crich.

A. Winstan Bond.  
March 1981.



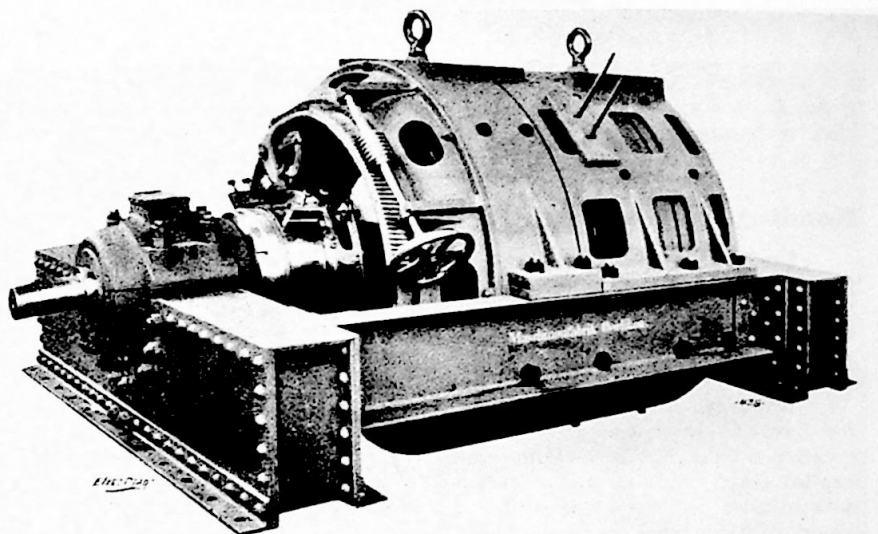


FIG. 3. 100 H.P. MOTOR GENERATOR FOR LOCOMOTIVE.  
(Oerlikon Co.)

# CHAPTER 1

## TWO REVOLUTIONS

### 1879-1979

★

#### ELECTRIC MOTORS INITIATE URBAN MOBILITY

# Two Revolutions

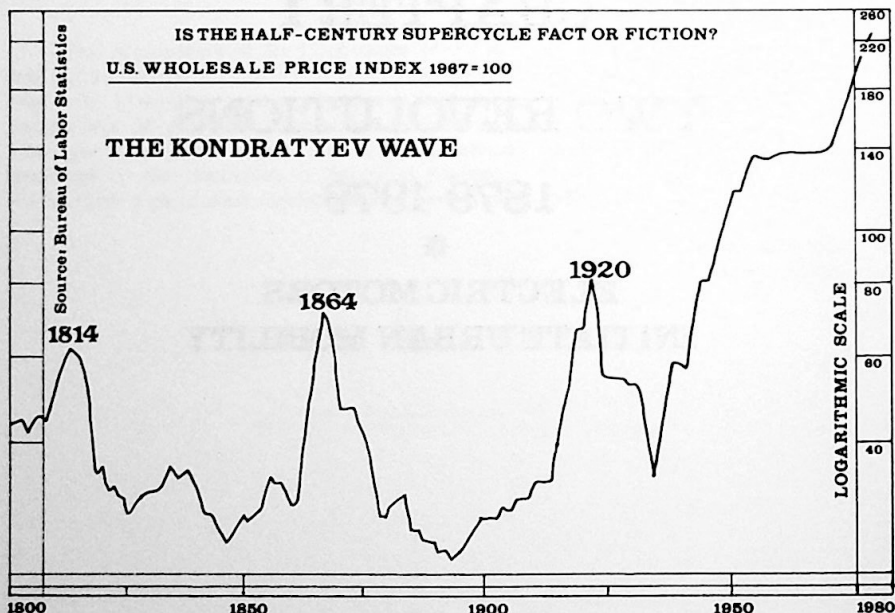
I should like to present to you a kaleidoscope of theories on the British Tramcar. My kaleidoscope covers the past and the future, reality and academic life, technology and psychology. I do not claim that all I am going to tell you is new, but I hope that it will be mentally stimulating.

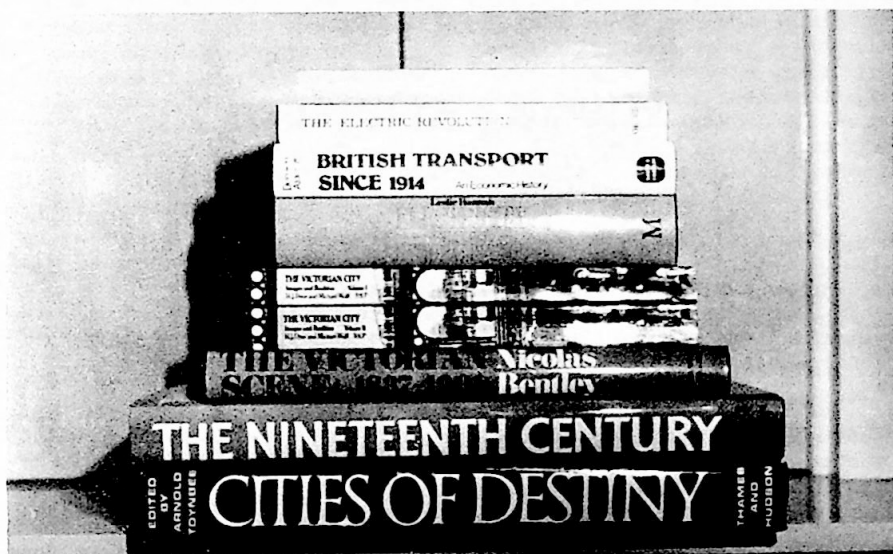
## Kondratiev Wave

During the 1920's a Russian economist, Nicoli Kondratiev suggested that capitalist economies were built around cycles of boom and depression lasting half a century. Because this theory contained a grain of hope for capitalism, by being self-correcting, Kondratiev fell out of favour with Stalin and died in a labour camp. Like many a prophet Kondratiev did not explain his prophecy.

However, to us the views of Schumpeter are relevant. Schumpeter links the waves to short bursts of technological innovation. These resulted in the creation of capital plant, followed by a coasting period where the excessive capital plant which is always created in any boom is used up and excessive debt eliminated. There is evidence that we are in a new Schumpeter upturn, based on electronics.

I shall later suggest that flowing from this electronic revolution the way in which history is researched and presented is being radically changed and new opportunities will be offered for tramcars. But first let us pause and look at the current historical verdict on the product of an earlier Schumpeter upturn - the electric tramcar, the child of the electrical revolution.





## CHAPTER 2

### HISTORY'S ORPHAN



#### THE ELECTRIC TRAMCAR - WHY DO ACADEMICS DISCOUNT IT?

# History's Orphan

The illustration at the head of the chapter shows the cover of a prestigious book, "The Nineteenth Century". The dust jacket says "Nineteenth Century Man crossed the threshold to a new world, a world which was changing more rapidly than at any time throughout history". The author goes into great detail, each concerned with a single theme that helped to form the world as we know it today; social revolution, the transformation of agriculture, the growth of cities...

A major chapter is devoted to population and urban explosion. The dust jacket features "the triumph of steam and electricity" copied from the Diamond Jubilee issue of the Illustrated London News and in conjunction with the rest of the blurb appears to promise the electric tramcar its rightful place in the sun. No such luck. The tram is hardly mentioned at all.

If we try other similar books such as "The Victorian City", we find marooned amongst pages of erudite statements the following "one contemporary Arthur Shadwell insisted, however, that the most important element in the recent improvement of English housing conditions was the electric tramcar which from 1896 made the outskirts of towns accessible to more people and presented private builders with more opportunities for profit". It is a great pity that these admirable volumes of "The Victorian City", which are indeed a standard work, do not take the opportunity to deal in far greater measure with this comment because otherwise I fear the tram is a very very poor relation. The railway on the other hand achieves a fair measure of eminence. A great deal of the credit for this must go to Jack Simmons for his excellent chapter "The Power of the Railway".

To refer to another book, "Cities of Destiny" edited by Arthur Toynbee, there is a 2,000 word index without a single reference to railways or tramways at all. The book is described as a magnificently illustrated history of the city, its origins and development. Or again, Nicholas Bentley's book "The Victorian Scene". This deals with trams in a couple of patronising paragraphs.

Let us move from town planning and social history to economics and look at "British Transport Since 1914", an economic history published at £12.50. The cover says everything. There is a modern oil tanker, a modern British Rail electric locomotive, a 1914 bi-plane and a horse tram. Or consider "British Transport, An Economic Survey from the Seventeenth Century to the Twentieth". The book is divided into sections on railways, motorised transport, shipping and aviation, but the tram is a brief interloper.

To move onto the electrical historians. There is "The Electric Revolution" by R. A. S. Hennessey. This is an admirable book and Mr. Hennessey says that next to public lighting the electric tram was the most obvious and dramatic example of electrical based progress between 1890 and 1910. But when he considers the tram it does not have a chapter to itself, unfortunately it comes under "electrical phenomena". Or take another electrical book "A History of Electrical Engineering" by Dunsheath. Several chapters are devoted to electrical telecommunications such as early telephones, submarine cables, and the telegraph and all appears not lost to the tram as there is a chapter entitled "Power and Traction". However, although the bits which go to make up a tram get mentioned here and there it is dealt with in a paragraph ending - "during this half century, however, the tramcar was an important branch of electrical engineering".

Let us finally consider a book just published, "Electricity Before Nationalisation" by Leslie Hannah and published by the Electricity Council at £15.00. There are many interesting allusions to the tramcar but I suggest they are never properly followed through. The author obviously realises the tramcar was important, indeed he says that sales of electricity to tramways before 1914 still amounted to 17% of all sales by public supply undertakings, even though the tramways still generated the larger part of electricity they used in their own stations.

So, what is the reason for trying your patience with all these lengthy quotations? I hope it is clear that there must be something wrong with our opinion of tramways, or with contemporary research by others working in different disciplines, if contemporary history written by non-tramway authors produces such condescending and almost absent minded treatment. Therefore, I ask the question, were tramways important or were they just an interesting interlude in the development of transport? We shall now examine the effect of the electric tramcar on our cities and I hope to show that the electric tramcar is indeed worth a greater mention than historians are currently granting it. A sub-theme in this part of the presentation will also concern reasons for the United Kingdom's delayed response to the electrical revolution. Following this we shall examine some of the seeds of destruction of the electric tramcar and then conclude with a look into the future. But first let us go back to a Victorian preoccupation - slums, and the lack of transport technology.





**CHAPTER 3**

**THE NEED**  
**FOR THE ELECTRIC TRAMCAR**

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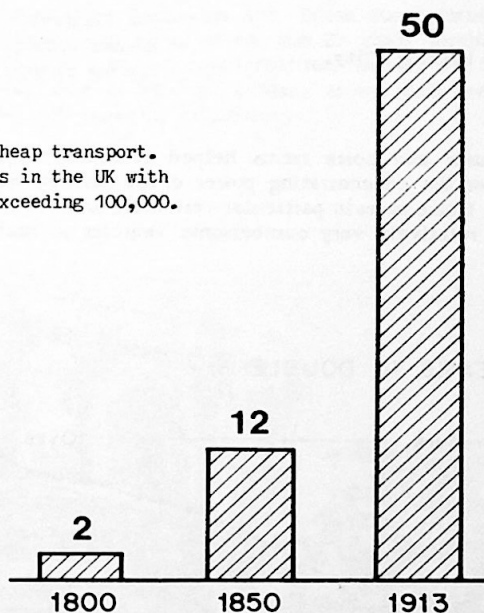
**THE PARADOX**  
**OF ITS SLOW DIFFUSION IN THE U.K.**

# The Need for the Electric Tramcar

## Slums and lack of transport technology

Before the industrial revolution cities were basically walking cities. In the eyes of some of the ancients the ideal size of a city was conditioned by the number of people who could gather together at any one time to hear an orator speak. The table of growth shows what a recent phenomena the city of 100,000 and more people is. The coming of the railway and steam engine concentrated industrial development into tight clusters.

One need for cheap transport.  
Growth of towns in the UK with  
a population exceeding 100,000.



Due to the limitations of the technology of shafts and pulleys each factory was within itself concentrated, and the workers lived near to. The inflexible nature of canals and railways which delivered the life giving coal and took away the finished products also resulted in industrial congestion as factories clustered around these lifelines.

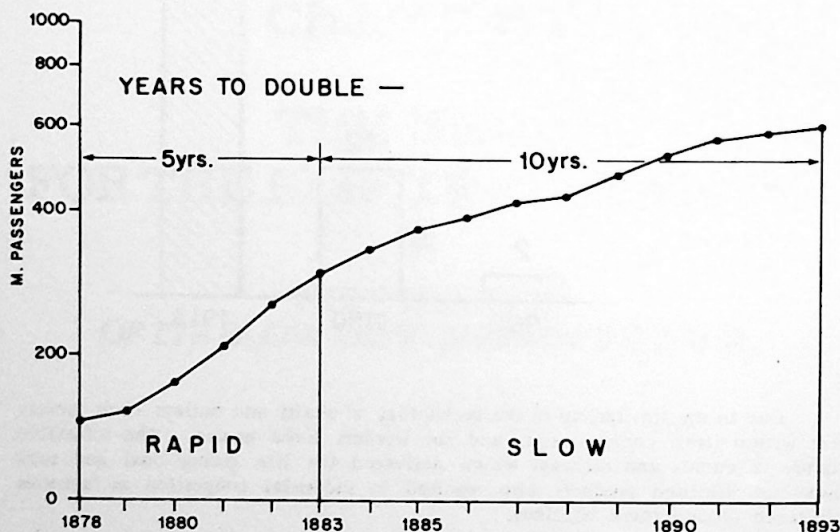


The Walking City.



The limitations inherent in the transmission of mechanical power added to physical congestion.

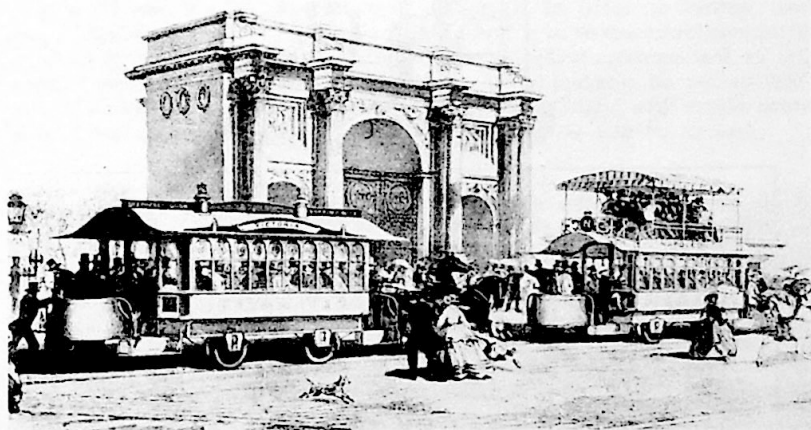
Horse buses and horse trams helped to move people but they could not compensate for the concentrating power of the railway due to their inadequate technologies. Horse buses in particular were more suitable to shoppers on boulevards as they were relatively very cumbersome vehicles to manoeuvre.



Growth of UK horse tram traffic. Source: Board of Trade Returns.

In the U.K. horse tramways began to spread after the introduction of the 1870 Tramways Act and the graph shows the very rapid growth, doubling in five years between 1878 and 1883, and the much slower growth between 1883 and 1893. But the introduction had not been easy. In 1858 when major shareholders in the London General Omnibus Company tried to obtain Parliamentary powers for tramways in London the Bill was rejected. Sir Benjamin Hall, Chief Commissioner of Works for Metropolitan London, moved the rejection of the Bill saying, "They asked for power to appropriate 16 feet in width of the public thoroughfares of the metropolis, in order that their omnibuses might run on rails laid for that purpose. Now as some of the public thoroughfares were only 18 feet wide, only one foot would be left on each side for the accommodation of carriages, carts and all the ordinary traffic. It must be admitted that there is hardly a thoroughfare in the metropolis at present sufficiently large to accommodate the existing traffic", and he, therefore thought it a monstrous proposition to ask permission to appropriate 16 feet of a highway to the purpose of a private omnibus company.

As is well known George Francis Train now entered the scene. But it was only in 1870 that we obtained our Tramways Act. Some commentators thought that as the Act did not limit fares or dividends the 21 years purchase clause, inserted as a result of pressure from the municipalities, should not restrict the promoters prospects of making a profit. Of course, as we shall see, they did not reckon with the effects of changing technology.



Train's First London Venture.

Also, the high fares of the horse trams and their slow speed did not enable the working classes to take advantage of them, they were substantially a middle class institution.

Before proceeding, it is interesting to note two minor points. Firstly, if British capitalists could not build horse tramways in Britain before 1870, then they would build them elsewhere; such as in Copenhagen, Brussels, Barcelona, Paris, St. Petersburg and Constantinople. For years to come "Duncan's Tramway Manual" was able to offer investors in tramway shares a wide geographical spread.

The second point to note concerns Mr. Bazalgette, Engineer to the Metropolitan Board of Works, who when appearing before the Select Committee on Metropolitan Tramways of 1872 proposed that as the asphalt pavement would soon be brought to a stage of perfection the public would have no need of tramways.



In 1892 Sydney Webb told the Royal Commission on Labour - "It appears to me that if you allow the tramway conductor a vote he will not be for ever satisfied with exercising that vote over such matters as the appointment of the Ambassador to Paris, or even the position of the franchise. He will realise that the forces which keep him at work for 16 hours a day for 3/- a day are not forces of hostile kings or nobles or priests; but whatever forces they are he will, it seems to me, seek as far as possible to control them by his vote. That is to say, he will more and more seek to ... obtain some sort of control over the conditions under which he lives".

A rhyme of the day said:-

All the world knows what you are  
Conductor of a tramway car  
Alas poor wretch for little pay  
You work for 15 hours a day  
I often wonder that a man  
Can spend his days upon a tram.

Unlike the men who would work 15 hours a day the horses could only work 4 to 5 hours a day. They were also subject to the most decimating epidemics.

Detailed research by others has shown that suburban railways were not very effective either in solving the problem of congestion. This was particularly due to the lack of cheap and speedy cross-town transport once the passenger had been delivered to the down town station, as well as the lack of proximity of most suburban stations to the suburban populations they were supposed to serve.

In the latter part of the 19th century another invention also added to the problem, the lift. This enabled even greater concentrations to take place in the centre of the cities. Originally hydraulically operated it soon became electrically operated.

This concentration of capital and people caused by the railways resulted in slums.

Just in case old pictures of slums look in any way picturesque the statistics make chilling reading, Glasgow being typical of our larger cities.

As early as 1870 the Lord Provost of Edinburgh had convened a meeting to consider the housing of the poorer classes. This concluded that horse trams could give the inhabitants of the congested districts a chance to spread out. It would then be possible to tear down the unsanitary houses in which they were living.

Almost as soon as horse tramways started to develop the search for an alternative form of traction became a favourite Victorian pastime. For some years steam trams were the main contenders but they were really equivalent to bringing the industrial revolution into the better part of town, and their smoke and noise were not wanted by residents who had the political power to control the streets. The steam tram did however establish the principal of mechanical traction on the road in this country. However, in order to further their art steam tram manufacturers, in the twilight years prior to the establishment of the system of Provisional Orders, had sometimes thought it more prudent to ship the engines abroad to test them. I think that it could probably be proved that here was an instance of this country developing a new technology, with export potential, despite the combined opposition of the municipalities and Parliament.

## CHARLES BURRELL & SONS, LTD., Thetford, Norfolk.

**NEW PATENT  
TRAMWAY LOCOMOTIVE.**

Perfect Condensation of  
Steam in all weathers.

Great Economy of Fuel.  
7 lb. to 8½ lb. of Coal  
per mile average.

Highest-class Workman-  
ship.

Uses less water than  
any other Engine.



**THE MOST  
SUCCESSFUL ENGINE.**

No Back Pressure.

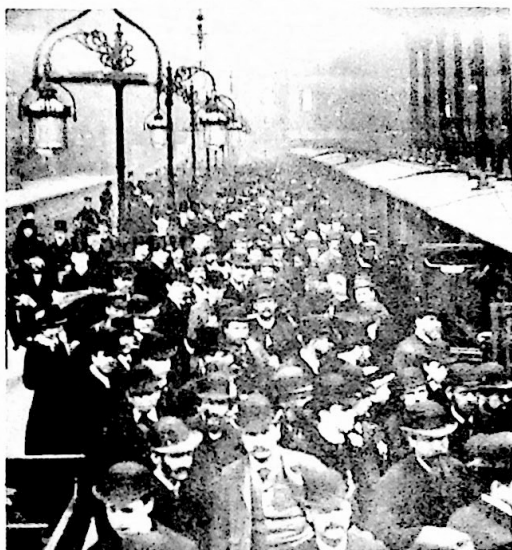
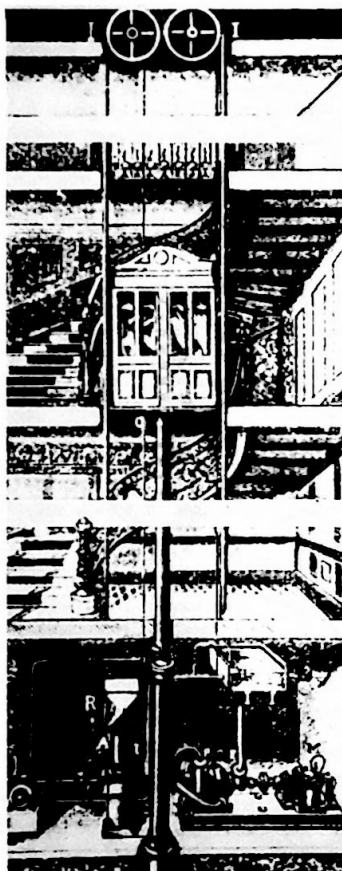
Suitable for Steep  
Gradients.

Engines Built to Suit  
all Gauges.

Specifications,  
Photographs, and Prices  
on application.

CAN BE SEEN AT WORK  
BY APPOINTMENT.

The freedom of the road for mechanical traction was won by the steam tram.



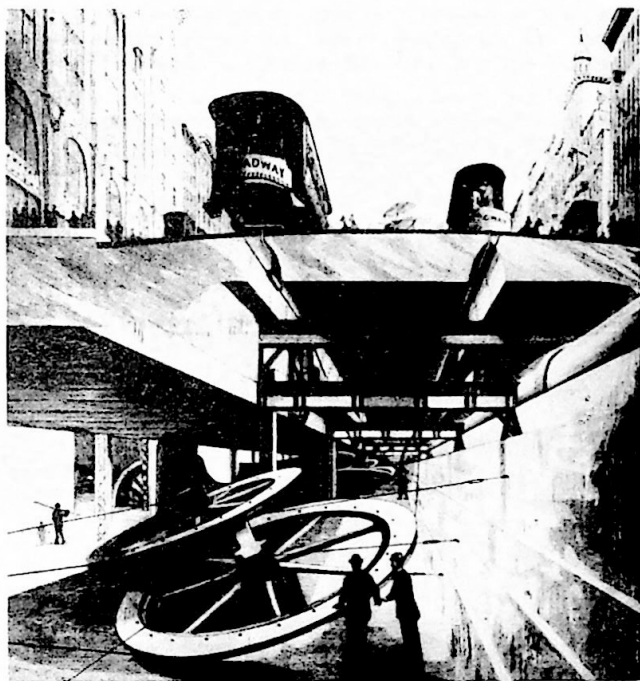
Above: The natural tendency of the suburban railway was to concentrate employment in the city centre.

Left: The lift, a hidden contributor to city centre congestion.

## GLASGOW OVERCROWDING 1891

90900 PEOPLE LIVING	187000 PEOPLE LIVING
3 TO ONE ROOM	5 TO TWO ROOMS
4	6
5	7
6	8
7	9
8	10
9	11
10	12

Another need for cheap transport. Source: Municipal Trading in Great Britain, Hugo R. Mayer, 1906.



The cable tram — capital intensive, brutal in operation and adopted too late.

The close timing of the births of the cable and the electric tram and the different nature of their fundamental economics confused many investors and tramway managers. As late as November 1897 the "Tramway and Railway World" snorted "we should dispel the ideas evidently too widely entertained that no further improvements are possible in cable traction, and that to other means of applying mechanical power one must look to advances. Such ideas, it should scarcely need remarking are totally erroneous, and cable haulage, with a fair field and no favour, has possibilities before it undreamt of by those who slightly pass it by".

Even the Americans were caught out. The Directors of the New York and Brooklyn Bridge cable railway were mesmerised with the considerable statistical advantage cable enjoyed over electricity in the cost per passenger carried, when the number of passengers to be carried rose above that required to cover cables' heavy fixed costs. As a result although all the carriages were equipped with electric motors and a third rail installed alongside the cable, electricity was only used for shunting and the all night service. This incorrect reading of the Accounts carried on until the opening of the East River Tunnel for the I.R.T. in 1908. Each car was equipped with a cable gripper, electric motor and controls and the mad scene was completed by the overhead wire and trolley pole used for the telephone system. However, do not laugh too hard. In Edinburgh in 1908 the cable trams were still considered competitive with electric cars.

Electricity had many false starts, a siren called the Accumulator being particularly disastrous on many an investor's pocket. During this time of hesitant progress the advent of the bicycle greatly helped the middle classes but the separation of home from the place of work still awaited a sensible solution.

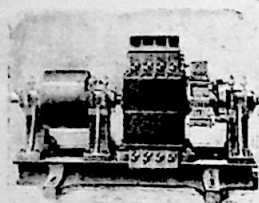
## GENERAL ELECTRIC POWER & TRACTION CO., Ltd.

MALDEN WORKS, KENTISH TOWN, LONDON, N.W.; and at 35, NEW BROAD STREET, E.C.

### DYNAMOS & MOTORS,

FOR ELECTRIC LIGHTING AND POWER WORK.

ELECTRIC DEPOSITION OF METALS



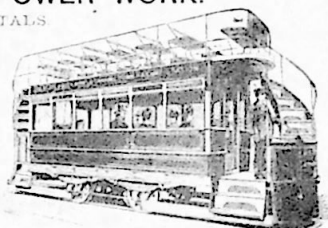
### ELECTRIC LAUNCHES

On the Thames for SALE or HIRE  
TERMS ON APPLICATION AT PLATT'S EXOT. HAMPTON

### ELECTRIC TRACTION

LINES EQUIPPED AND CONTROLLED.

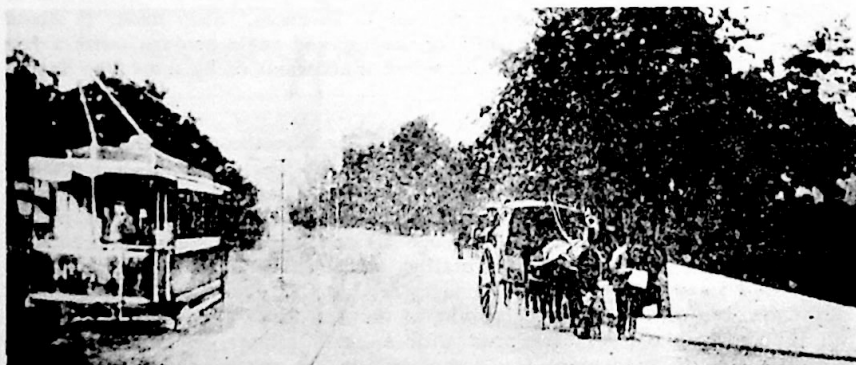
The North Metropolitan Tramway Co. Ltd. are on the Barking Road now run by Electric Cars supplied by this Company.



ESTIMATES AND FULL PARTICULARS ON APPLICATION.

Battery traction - an evergreen mirage.

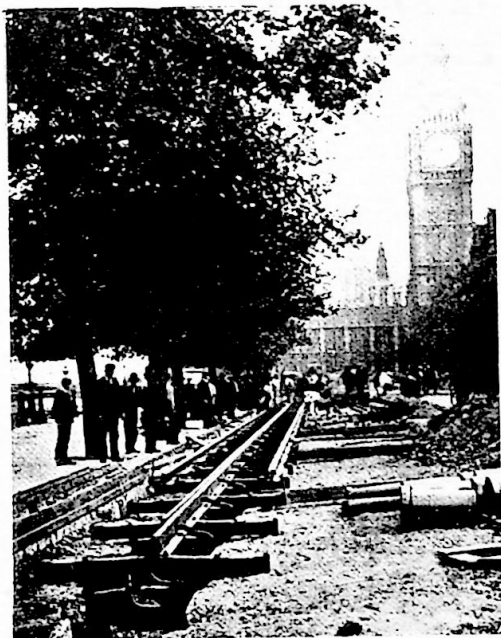
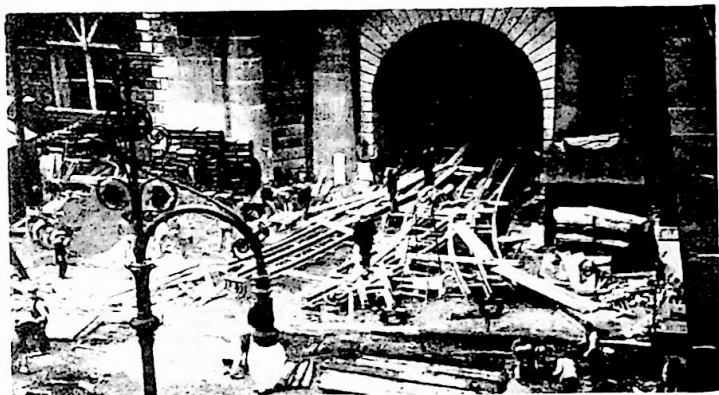
As every tramway historian knows environmental considerations are not a recent preoccupation. At the end of the last century many a classical city, proud of its squares, avenues, palaces, monuments and vistas, found itself surrounded by an industrial belt. From this grew the need for a tramway. Horse tramways fitted in without any obvious visual intrusion but to string overhead wires would in the eyes of many have been sacrilege. London was no exception in its self-regard. To counter this the "Electrical Review" published this photo montage of a L'Havre tram on the Embankment. But to no avail.



The Embankment, London, and a L'Havre overhead wire tram dubbed in for promotional purposes.

## Conduit track

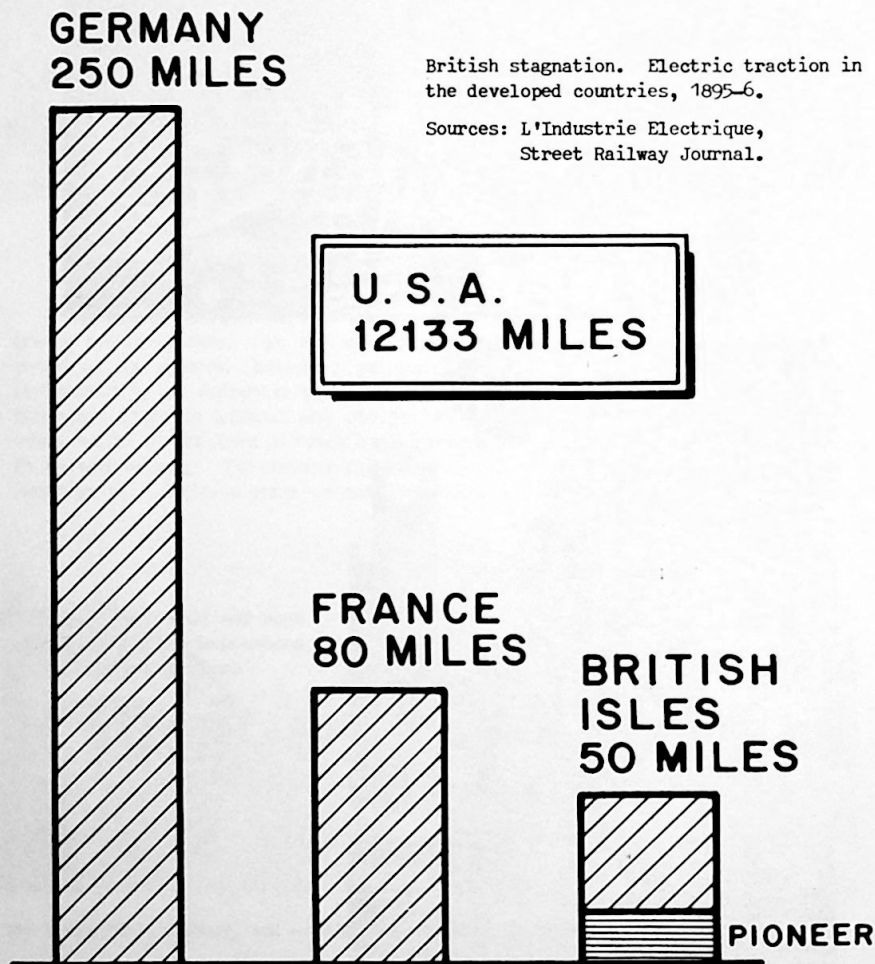
As ever, beauty comes dear. Conduit provided a solution for a price. It was really the hallmark of capital cities - such as Berlin, Brussels, Vienna, Paris, Washington and London as the illustrations show, on the Victoria Embankment. For the adventurous with a more limited purse there were the alternatives of accumulator traction and surface contact.



When the time came, fastidious London sank extra millions into conduit operation.

## "The British Disease"

From 1888 the solution to the problem of urban transport had been obvious - electric tramways on the overhead wire principle. The bar chart shows the growth in the seven years to 1895 of the electric tramway in the four countries which made up between themselves 73% of the world's industrial production by value added. The hopeless position in the British Isles is readily apparent particularly when one takes out from the cumulative figure such pioneer lines as Holroyd Smith's conduit tramway at Blackpool and Traill's third rail line at Giants Causeway. By 1902 nearly half of Europe's electric tramway mileage was in Germany.



British stagnation. Electric traction in the developed countries, 1895-6.

Sources: L'Industrie Electrique, Street Railway Journal.

(33 & 34 Vict)

Tramways

(CH.78)

An Act to facilitate the construction, and to regulate the working of tramways.

(9th August 1870)

Be it enacted by the Queen's most Gracious Majesty, and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled and by the authority of the same, as follows:

Preliminary

1. This Act may be cited for all purposes as "The Tramways Act, 1870".

2. This Act shall not extend to Ireland.

3. For the purposes of this Act the terms herein-after mentioned shall have the meanings herein-after assigned to them; that is to say,

The terms "local authority" and "local rate" shall mean respectively the bodies of persons and rate named in the table in Part One of the schedule (A.) to this Act annexed:

The term "road" shall mean any carriageway being a public highway, and the carriageway of any bridge forming part of or leading to the same:

The term "road authority" shall mean, in the districts specified in the table in Part Two in the schedule (A.) to this Act annexed, the bodies of persons named in the same table, and elsewhere any local authority, board, town council, body

ELECTRIC LIGHTING ACT, 1882

(45 & 46 Vict. c.56)

An Act to facilitate and regulate the supply of Electricity for lighting and other purposes in Great Britain and Ireland.

(18th August 1882)

Preamble

1. Short Title.- This Act may be cited for all purposes as the Electric Lighting Act, 1882.

2. Application of Act.- (Repealed by the Electricity Act, 1947)

3. Granting of licenses authorising the supply of electricity.-  
(Repealed by the Electricity Act, 1947)

4. Granting of provisional orders authorising the supply of electricity.-  
(Repealed by the Electricity Act, 1947)

5. Making rules as to application, etc., under the Act.-  
(Repealed by the Electricity Act, 1947)

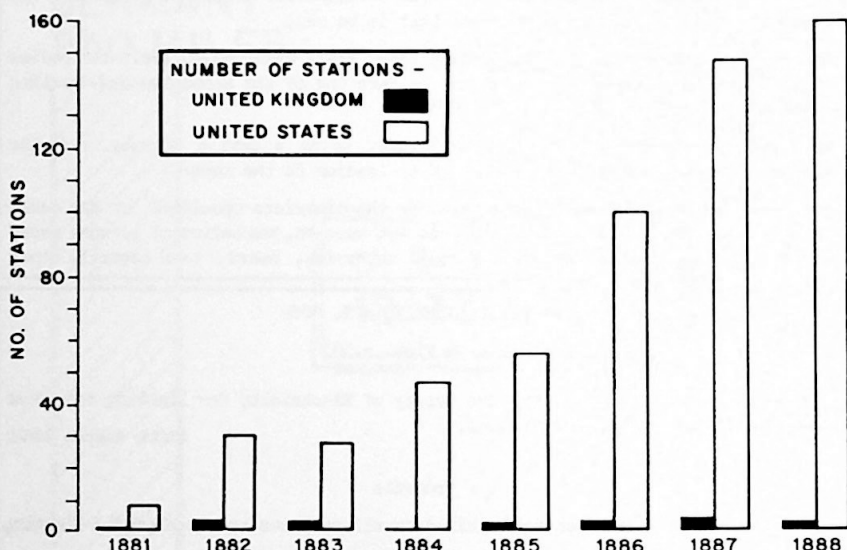
6. Regulations to be inserted in licenses etc.- (Repealed by the Electricity Act, 1947)

7. Expenses of local authority.- (Part of this section was repealed by the Local Government Act, 1933. The remainder is repealed by the Electricity Act, 1947)

The best laid plans.....

.....of mice and men.

The usual reason given for the U.K. being a decade behind is the 21 years purchase clause contained in the 1870 Tramways Act. I shall now suggest that the break on experimentation and investment caused by the municipality's insistence on having the 21 year purchase clause in the Tramways Act applied to a greater area of this country's industrial development than is generally realised. Following this I shall suggest a further major factor for our backwardness connected to the U.K's response to the Schumpeter Wave of 1895. The electric revolution started in the street, with lighting, telephones and tramways, and this was the basic problem, because Joseph Chamberlain and many of his contemporaries considered that the streets belonged to the municipality. Joseph Chamberlain was the Minister responsible for the Electric Lighting Act of 1882 into which he inserted the 21 year purchase clause.

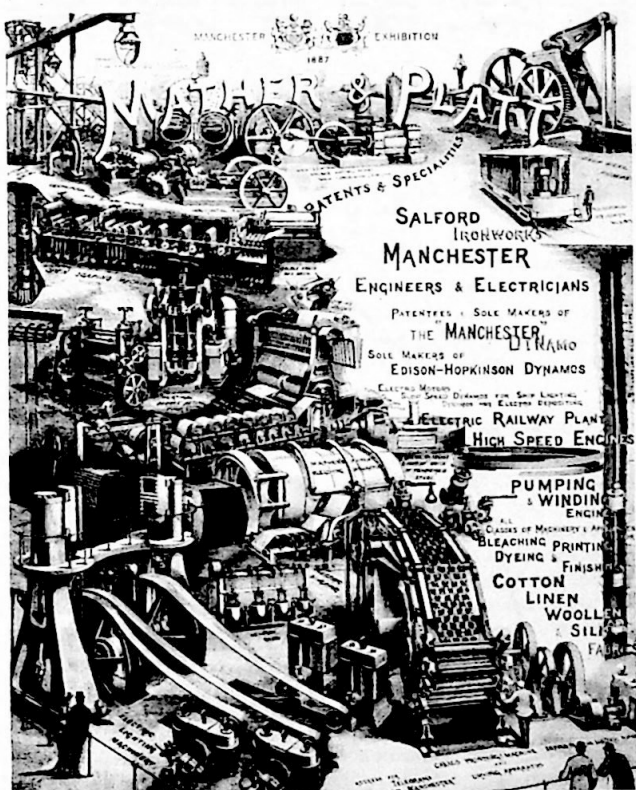


British stagnation again. Number of central electric stations supplying current to the public, built each year from 1881 to 1888.

Source: *Municipal Trading in Great Britain*, Hugo R. Meyer, 1906.

The bar chart shows the effect that this had on the electrical industry in the U.K. compared with the U.S.A. Between 1881 and 1888, the Americans built 564 electric generating stations supplying current to the public. Experience in the U.K. was basically confined to marauding companies. These were companies which stretched their wires from house top to house top and across the street, above the so called area of ordinary user. Under these circumstances capital expenditure necessary for a successful commercial undertaking on a large scale was totally precluded and a British industry had no chance to develop. So, when there was an eventual demand for power stations to supply electric tramways we, as indeed did the Germans who were similarly constrained, had to import American technology.

As a result when major British based electrical manufacturing companies were eventually established they were foreign inspired - Siemens Brothers, Anglo-American Brush, General Electric and Westinghouse. The American period of British electric tramway development is familiar, so I shall not dwell on it. Mather & Platt of the "homegrown" companies are well known for their association with pioneer developments in electric traction world wide, but they did not develop their technology and fell out of the race. The Electric Construction Company fared no better. Despite backing from Emile Gärcke and successful work on the South Staffordshire Tramway and the Liverpool Overhead Railway the company foundered when it failed to get payment for a side slot conduit tramway it built at Madras. Dick Kerr is the nearest to an exception to prove the rule, as it had British management and capital. However, the technical direction was American. John Price, the historian of the U.K. Tramcar Building Industry, estimated that in its peak year the industry had a capacity of about 2,500 tramcars.



Mather & Platt, after a promising start, an early loser in the race to become a great electrical equipment company.

PERSONS

4.3 -

4.2 -

4.1 -

4.0 -

1851

1861

1871

1881

1891

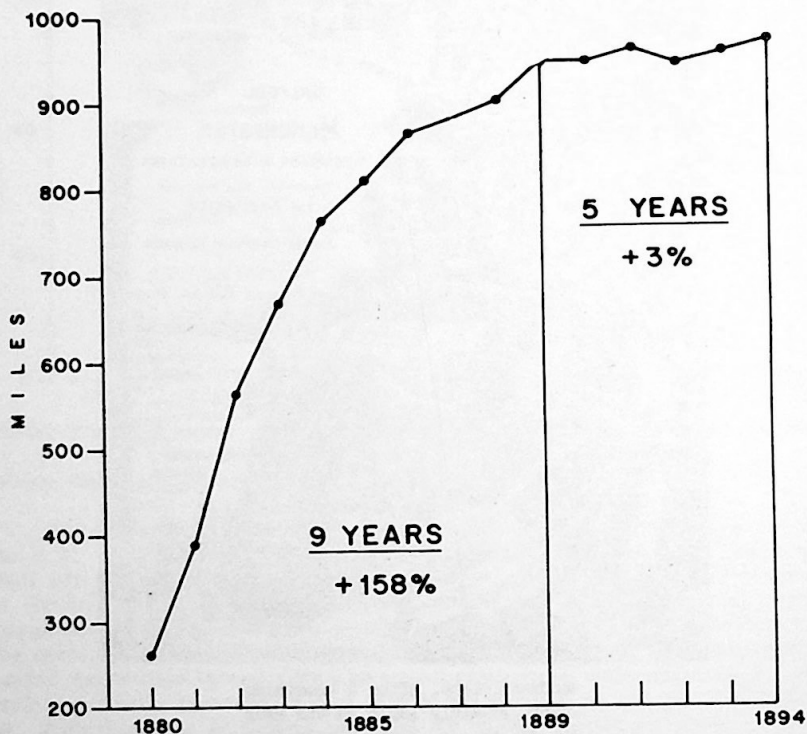
1901

1911

Number of adult equivalent persons per house, 1851-1911. The missing house boom - a brake on tramway development.

Sources:

Growth & Fluctuations 1870 - 1913, W.Arthur Lewis, 1978.



Growth of UK tramway mileage 1880-1894 and the brake on development.  
Source: Board of Trade returns.

Of course, not all American technology worked first time. Their free and easy attitude towards the establishment of electric tramways also led to some pretty cavalier situations. Pitched battles in the street between rival tramway contracting companies and attempts to lay lines through towns at the dead of night before anyone could get an injunction were quite common in the U.S.A. But they all added up to vigorous growth, technological innovation and ultimately technological leadership both in manufacturing capacity and capability. As an eminent British consulting electric engineer, J.A. Flemming, said in 1901, "the period since 1870 has not been marked by the evolution of distinctly novel electric inventive ideas preceding from British minds". He linked this to the educational, legal and social fossilisation of the country.

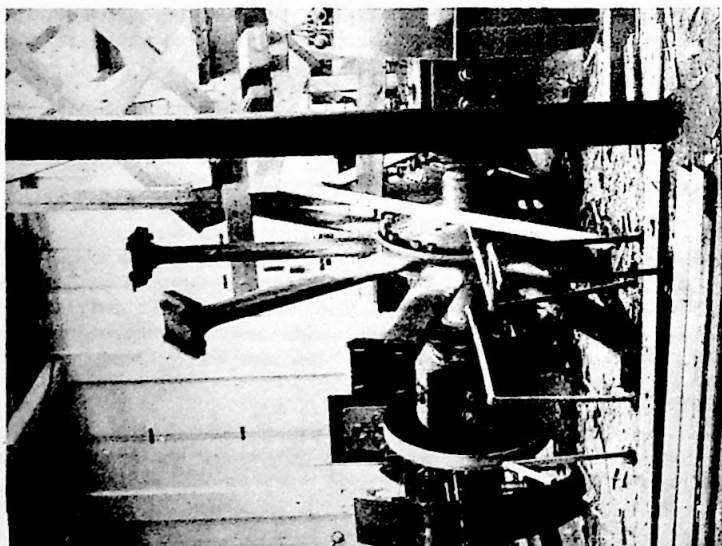
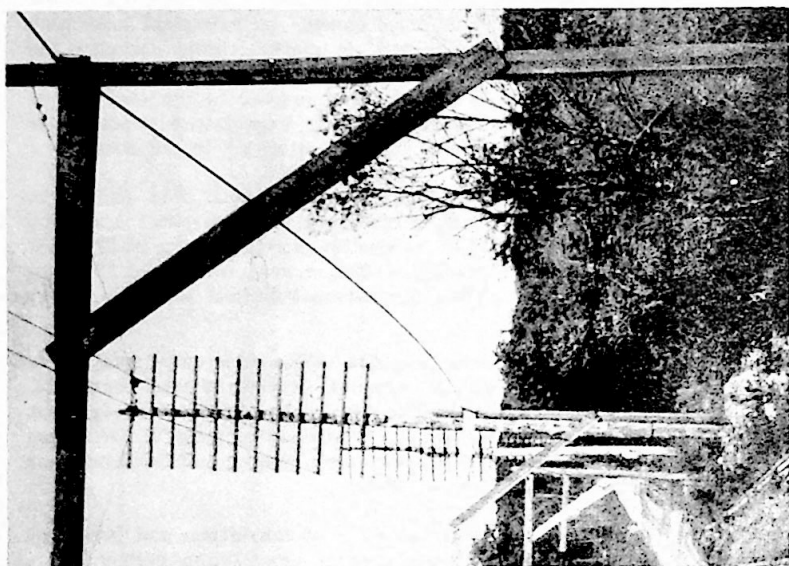
We now return to economics. Remember Schumpeter who linked the upturn in Kondratiev waves to short bursts of technological innovation? According to Schumpeter the upturn in the first Kondratiev waves starting in 1790 was concerned with the use of the steam engine. The second, starting in 1844 was based on the spread of railways. These formed the industrial revolution which created Britain's wealth.

The third Schumpeter upturn commenced in 1895, and created totally new products such as telephones, typewriters and cameras. It involved steel, chemicals, electricity and the internal combustion engine. In essence there seems evidence that Britain was too complacent, mature and fossilized to properly participate in the new opportunities but in their different ways, France and Germany were invigorated by the Franco-Prussian war of 1870.

In Germany the number of towns of 100,000 inhabitants and over grew from 8 in 1871 to 48 in 1910. Germany's rapid urbanisation called forth a host of electrical firms and in 1913 it produced 20% more electrical power than Britain, France and Italy combined. Hydro-electricity brought sudden industrialisation to Alpine France and electromechanical and chemical industries forged ahead.

At this time urbanisation was equal to industrialisation. A feasible rate for urbanisation was conditioned by the acceptable rate of migration from the land, the infrastructure for building and the provision of capital. Manufacturing became depressed in the U.K. as it gave up new industries. For instance, in 1882 Britain supplied Germany, France and the U.S.A. with a sizeable percentage of their steel but did not modernise its steel production and became the world's largest importer within a few years. In the U.K. also, equity capital was being exported at a maddening rate. By 1914 U.K. foreign investments were greater than those of France, Germany and the U.S.A. combined. As manufacturing became depressed, construction became depressed and the number of people living in a house went up. The bar chart shows that there should have been a housing boom in the mid-1880's.

My previous comments and the lack of a housing boom suggests one reason for the flattening out in the growth of tramway mileage in the U.K. - a depressed construction industry due to a depressed manufacturing industry.



Accidents and improvisation with some American installations were just the other face of a dynamic industry.

## "Electric Tramway Mania"

The graph shows the capital raised for electrical undertakings as shown by Garcke's Manual. Traction is very apparently the most vigorous and largest element. It does of course include not only the electrification of London's underground but the capital raised for tramways abroad.

So far as electrical power generation was concerned the Fabian Society said "it is at once discovered that the private companies have picked out the industrial eyes of Great Britain". They said that "the tramways, the light railways and the railways must be regarded as the modern form of the King's Highway". In consequence they proposed "a Central Transit and Power Department organised to meet modern ideas and to safeguard the public convenience and protect the community from monopoly in the hands of private companies. It should maintain a small army of scientists and investors whose only business shall be to improve traction and simplify electrical production".



City of Hull

ELECTRIC TRAMWAYS.



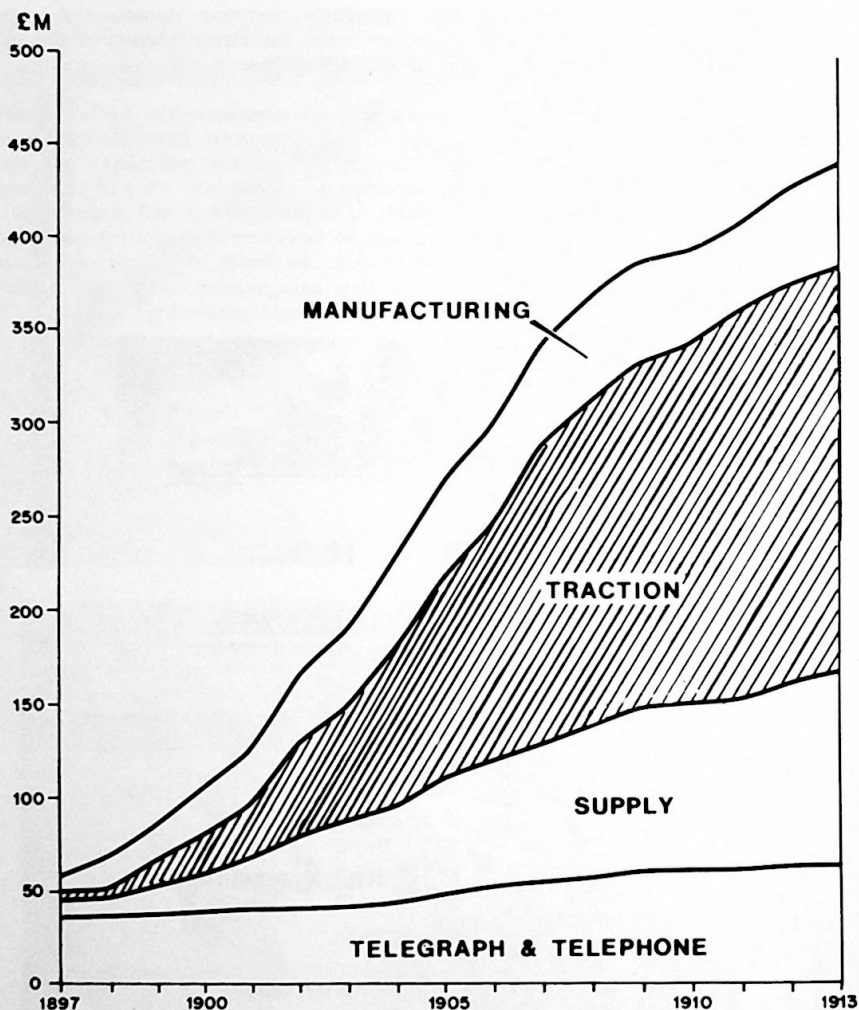
rogramme

of arrangements for

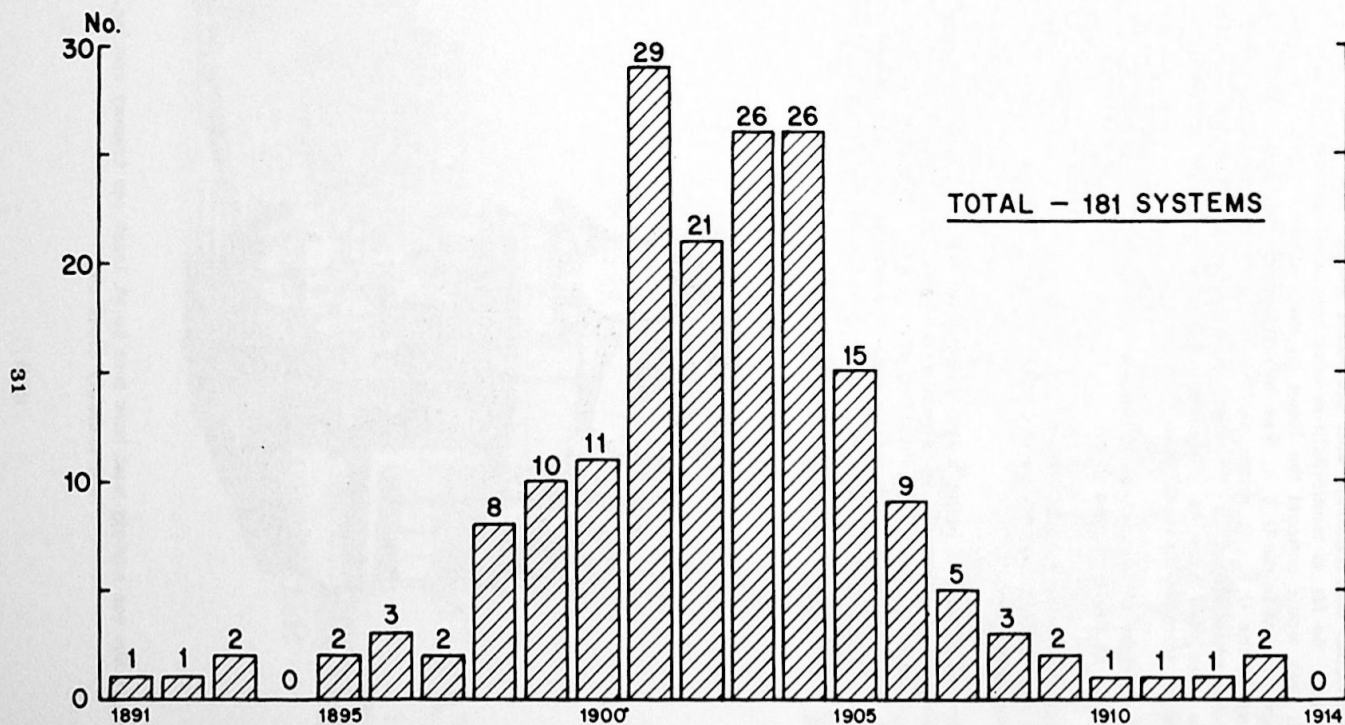
Opening Ceremony.

Wednesday, 5th July, 1899.





Aggregate subscribed capital of electrical undertakings, 1896-1913, showing the importance of traction to the development of the electrical industry.  
Source: *Manual of Electrical Undertakings, 1913-1914*, Emile Garcke.



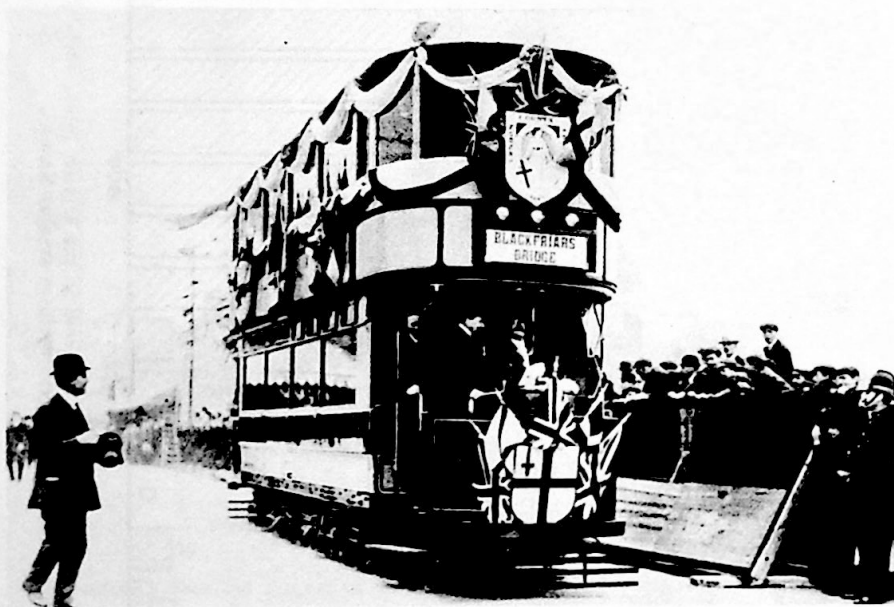
Electric tramway systems opened in the British Isles, 1891-1914. A pattern 10 years behind America and Germany.  
 Source: F.J.O'Connor (The National Tramway Museum).

The belief that tramways were profitable brought them to even the smallest settlements. So far as municipalities were concerned another desirable feature was that they would conceal the losses on their electric lighting stations. An important element in the U.S.A. was in fact property speculation but this worked in reverse in the U.K. as municipalities did not like extending outside their limits even when allowed to in order not to lower their own rate income. So 10 years later than America, Germany and France, Britain enjoyed the feast of perpetual tramway opening days.

The height of municipal pride was for a mayor to get his wife behind the controls of the first days tram.

Electricity was brought to the daily lives of ordinary people. In one area at least the Fabians need not have worried - electric tramways were increasingly municipal tramways.

One advantage of being a late entrant was the more stable technology of the industry. For instance, in America the cost of constructing an electric tramway had fallen by a third by 1896 and the cost of electric motors by two thirds. Worse still from the point of view of operators who were established in say 1890 - their rolling stock could have been on its fourth set of motors by 1900.



Anybody who was anybody must have been to at least one tramway opening, and probably drove too.



## **CHAPTER 4**

# **THE GIFT OF THE ELECTRIC TRAMWAY**

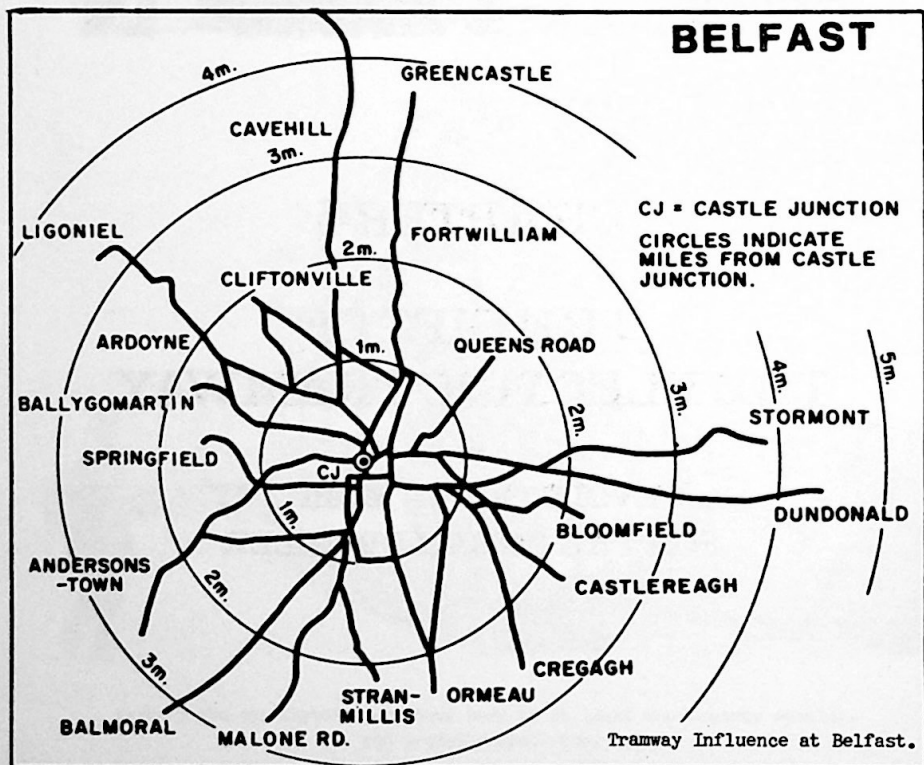


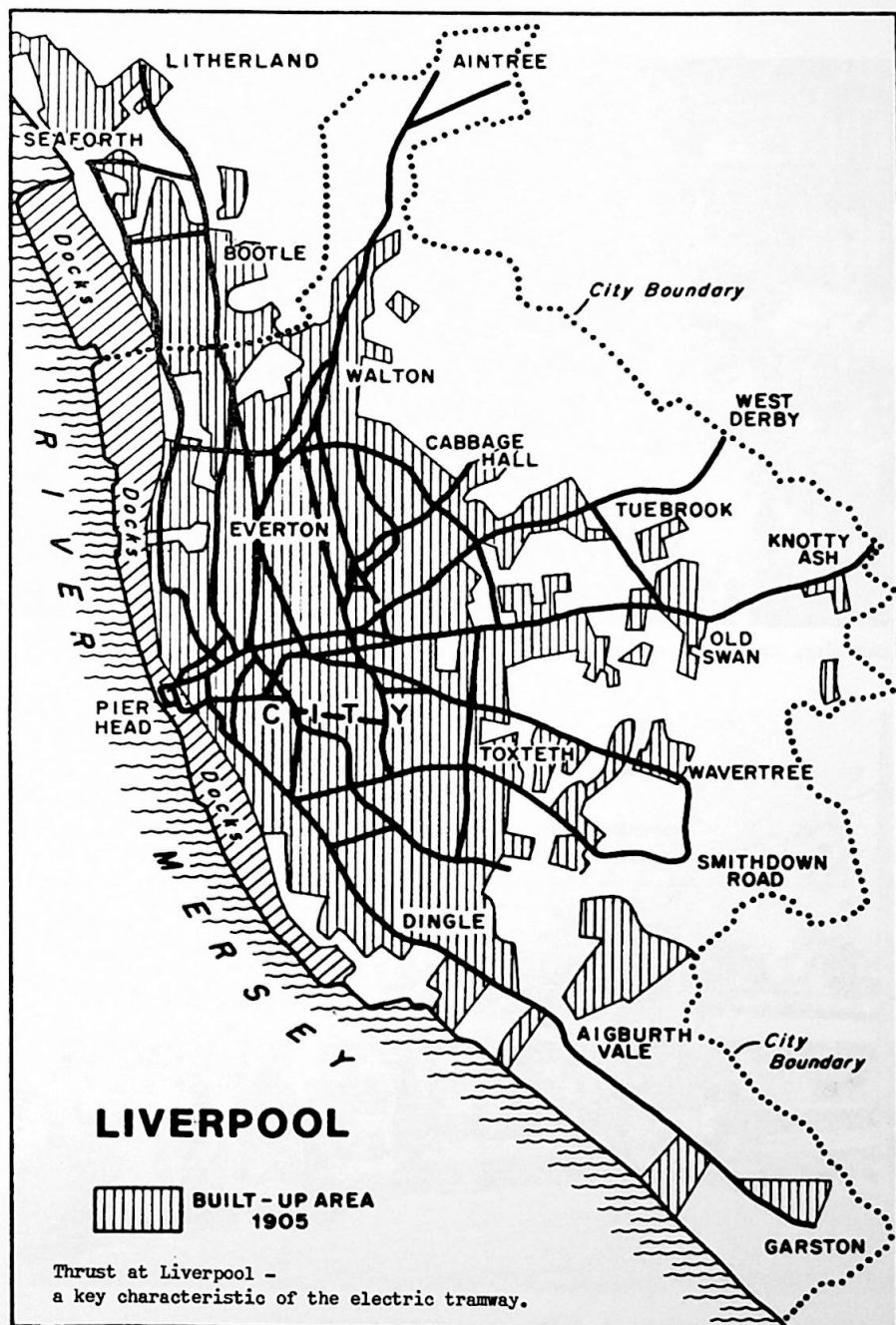
**A REVOLUTION IN MOBILITY  
FOR THE URBAN DWELLER**

# The Gift of the Electric Tramway

## Dynamic forces

Let us now examine some of the key characteristics of the electric tramcar, the first being thrust. The map of Belfast gives a hint of the effect of the tramcar as it radiates out in all directions. In Liverpool, observe the city boundary restraining the extent of the tram except in one specialised instance. See how it covers all built-up areas as well as giving the possibility of expanding into the countryside. It could be said that the situation in Liverpool in the early electric days was very similar to the latter days of the horse; this is true, and we should consider therefore the next series of key characteristics.







Capacity, speed, reliability and frequency at Nottingham — key characteristics of the electric tramway.

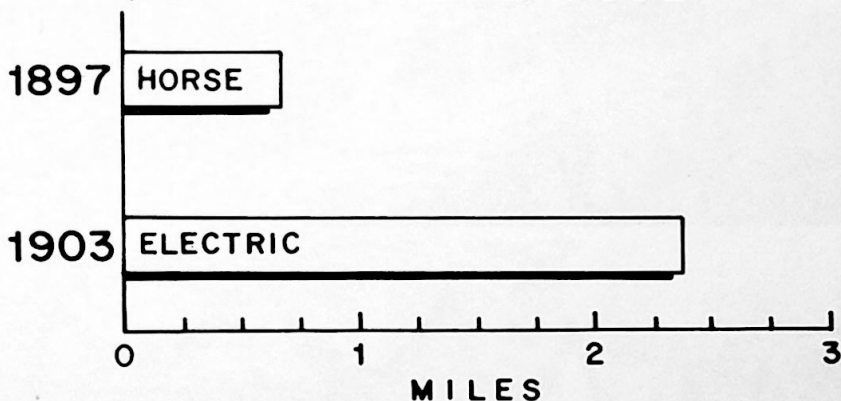


A similar promise for Dartford.

Compare these features, capacity, speed, reliability and frequency, with the equivalent of a horse tramway and relate them to the requirements of a working man in Edwardian times. The horse alternative in many cases is irrelevant to him whereas the electrical proposition opens a whole new way of life.

No matter how fast or reliable the electric tram was, it would not have served its purpose unless it was cheap to use. As the chart shows the distance a passenger could go for 1d in old money on the electric tramcar was several times its horse equivalent. In 1912, 28 undertakings had a  $\frac{1}{2}$ d stage for up to  $1\frac{1}{2}$  miles and Birmingham gave a 3.9 mile for 1d workman's fare. This facility being used by over 15m people a year.

## COMPARATIVE DISTANCE FOR 1d. FARE AT LIVERPOOL



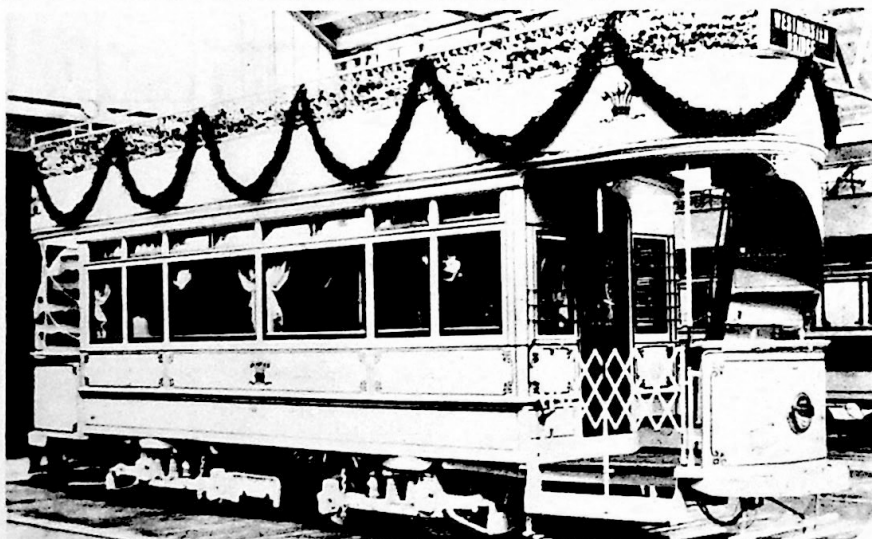
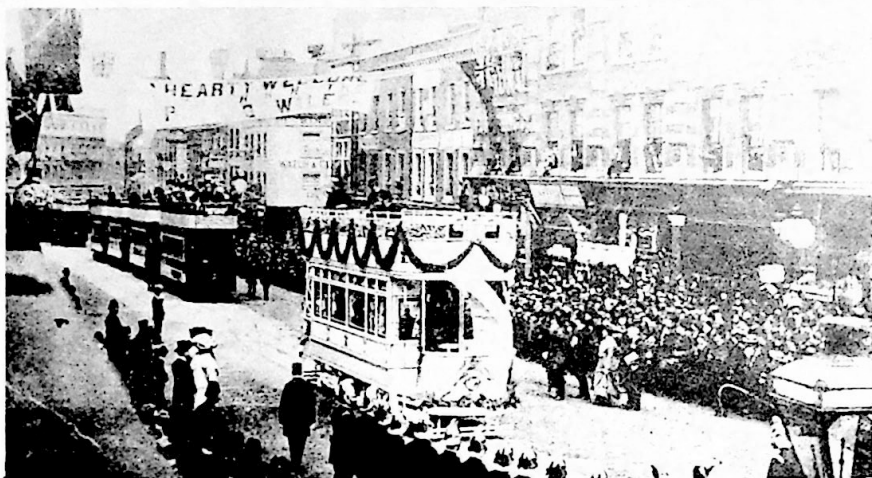
APPROX. PERCENTAGE OF 1d. FARES IN 1903

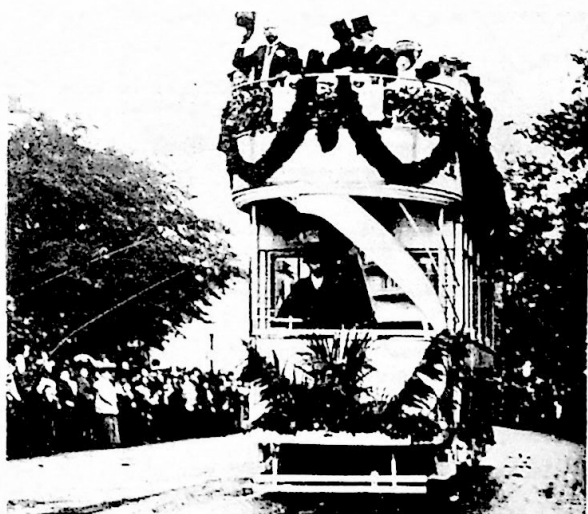
89%

Cheapness, a key characteristic of the electric tramway.  
Source: Liverpool Transport Vol.I, J.B.Horne & T.B.Maund.

## The Electric Star

The Royal opening of the London County Council Tramways was appropriately heralded by the issuing of a Royal Ticket. "The Tatler" said, "new responsibilities will be added to Royalty if hard working Kings and Princes, in addition to laying foundation stones and planting trees, are to be called upon to drive tramcars". Although the Royal party did all the obligatory junketing the journey ended up with what for the L.C.C. was the reason behind it all, new houses for the working classes.





LONDON COUNTY COUNCIL  
ELECTRICAL TRAMWAYS  
Inauguration by H.R.H.  
THE PRINCE OF WALES.  
15th MAY, 1903.

SOUVENIR TICKET

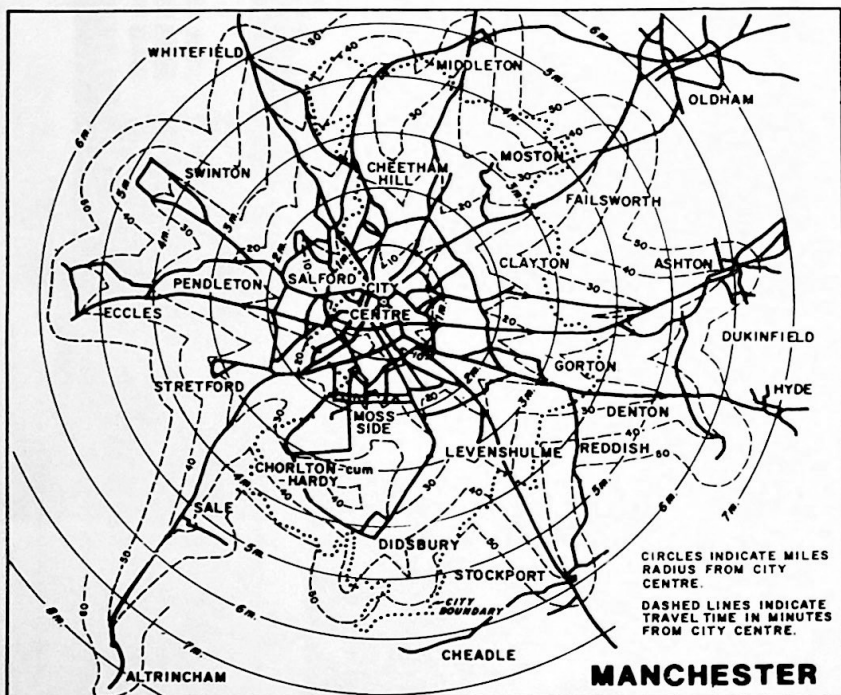
1

DOWN & UP

DOWN	UP
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
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10	10
11	11
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45	45
46	46
47	47
48	48
49	49
50	50

The first ticket, which  
was sold to the Prince  
for one halfpenny.

The map of Manchester shows the starshaped pattern which will have been evident from the earlier illustrations. The ease and speed with which journeys could be made across Manchester is indicated by the time lines on the map. With early petrol lorries easing the congestion caused by horse drawn wagons there was possibly a brief period when transport in some cities was in the beautiful form of equilibrium.

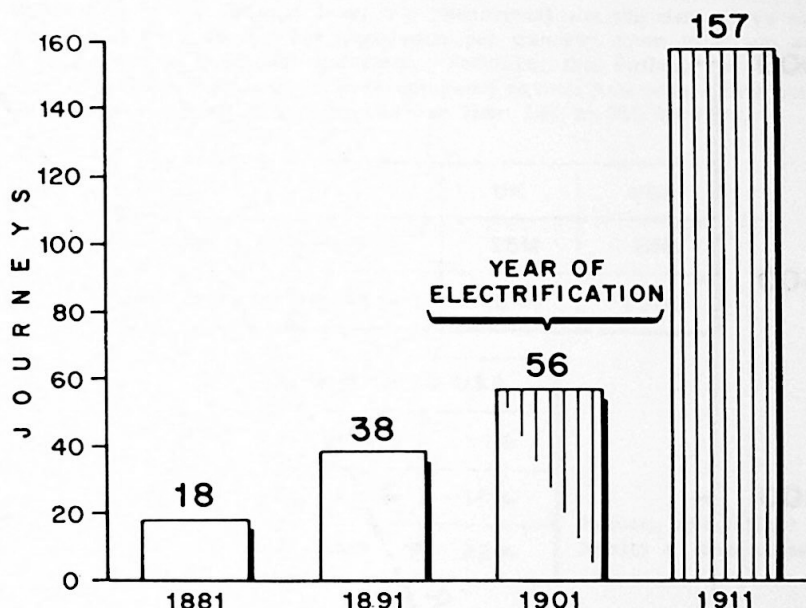


Manchester and the Electric Star. Freedom of mobility for all.

Source: The Passenger Transportation Problem - Manchester Tramways Department, 1913.

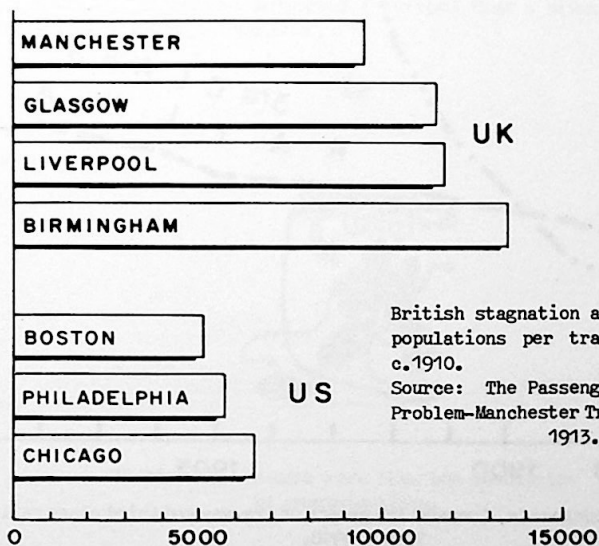
Reproduced by kind permission of the Manchester Transport Historical Society.

On the introduction of electric tramways the journeys per head of the population shot up dramatically. I suggest that the importance of this vast jump in journeys per head, not only in Manchester but in all other cities, is being forgotten as it represents for the average person the beginning of the mobility which we now take as a birth-right with the motor car.



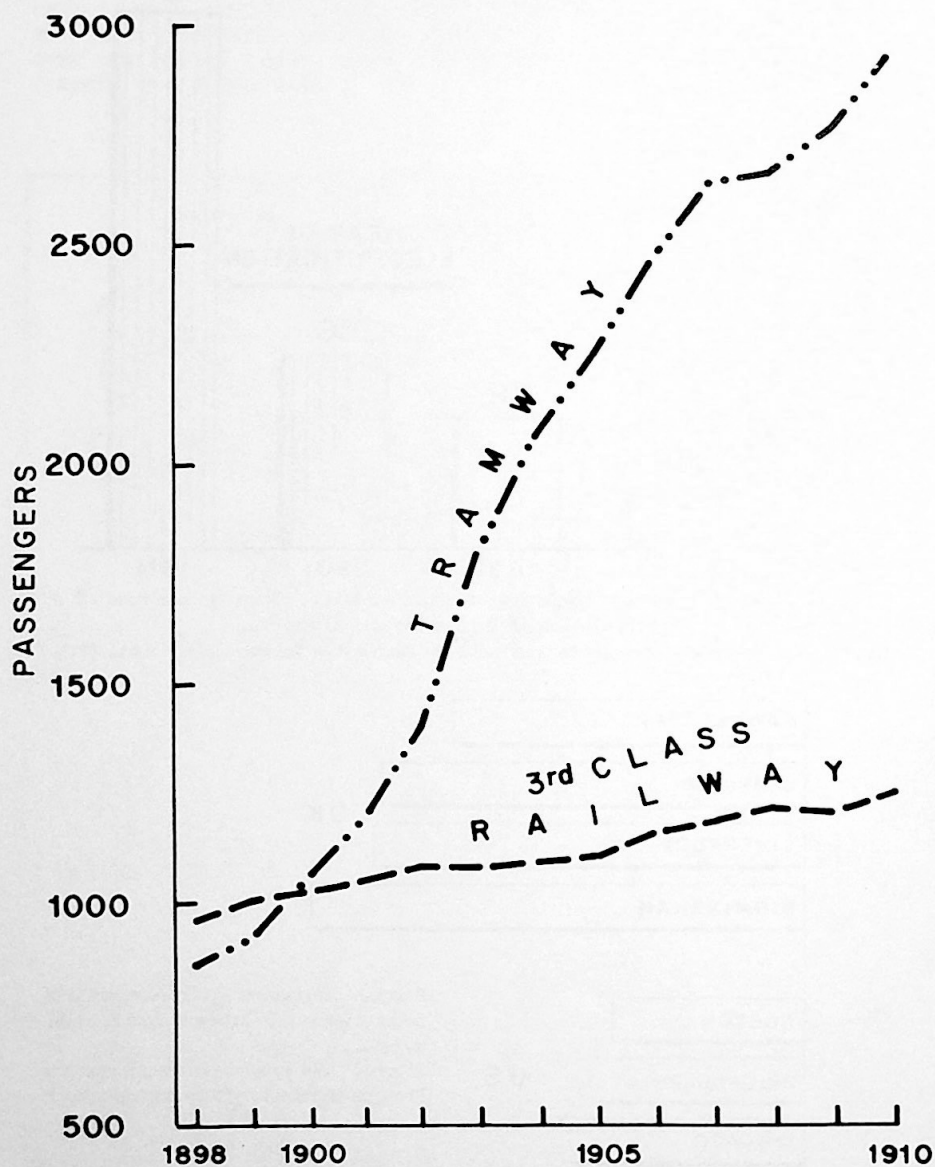
Electrification and the beginning of urban mobility. Journeys per head of population in Manchester and district.

Source: The Passenger Transportation Problem - Manchester Tramways Department, 1913.



British stagnation again? Comparative populations per tramway route mile, c.1910.

Source: The Passenger Transportation Problem - Manchester Tramways Department 1913.



Urban mobility on a national scale. Comparative growth of tramway and third class railway passengers, 1898 - 1910.

Source: Manual of Electrical Undertakings, 1913 - 1914, Emile Garcke.

The graph of tram passengers compared with the third class railway passengers shows on a national level how phenomenal was the rise. Even so we lagged behind America. The population per tramway route mile was about three times the American equivalent. Following this further, the facilities which the U.K. population enjoyed compared to their American equivalents so far as urban tramways was concerned rose from 16% to 22% by 1904.

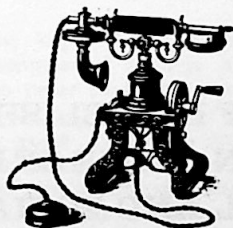
	UK	USA
1900 URBAN POPULATION	25M	24M
1904 URBAN TRAMWAY MILEAGE	1840	8300

% UK TO USA	
1880	16%
1890	18%
1904	22%

American speculation?  
Density of urban tramways.

Source: Municipal Trading in Great Britain, Hugo R. Mayer, 1906.

Figures for the electric lighting and telephones show that a British person living in a town had only a quarter of the facilities his American equivalent would have had. Despite this difference I contend that a revolution in personal mobility did take place in the U.K.



Electricity brought more than one revolution  
in communications.



## **CHAPTER 5**

# **THE SEEDS OF DESTRUCTION**



**THE FATE OF ESTABLISHED CAPITAL  
INVESTMENT IN A TIME OF INFLATION AND  
TECHNICAL AND SOCIAL CHANGE**

# The Seeds of Destruction

## Inflation comes to Utopia

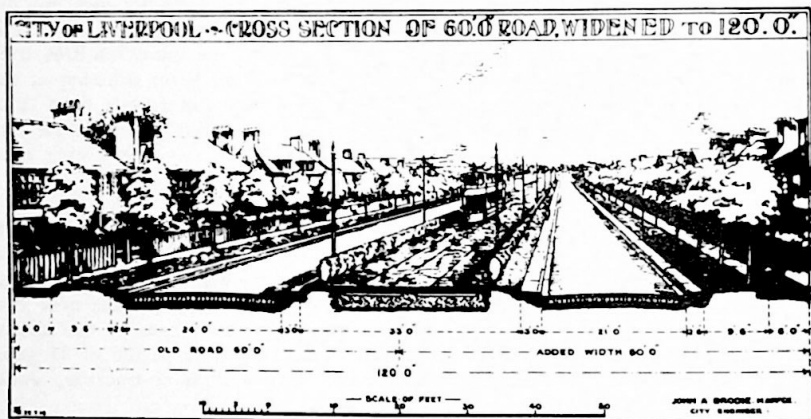
We have just seen how the electric tramcar conferred the gift of mobility onto the vast majority of the urban population. However, on its own this did not get rid of the slums. Our American cousins argued that one reason for this was the lack of a flat fare. Unfortunately in the U.K. the municipalities tried to reach utopia in all directions at once. In particular I am thinking of the reductions in the working week, the policy of only buying materials from firms that paid a minimum wage, and the desire to make regular payments for rate relief. All this was to be done on lower and lower fares. There were even demands for farthing fares.

In 1904 Mr. John Young, General Manager of Glasgow Corporation Tramways, warned the Corporation that "we cannot afford to look upon obsolescence of plant as only a bogey in these times of abnormal progress. In this connection, it should not be lost sight of that our capital expenditure is at present over £2m sterling. It is true we are paying off our large debt by means of the sinking fund; but we cannot be sure that long before the sinking fund period of 31 years has expired much of the present plant, and even our system of traction, would not have become obsolete".

An American economist calculated that a doubling of the average Glasgow fare, which was paid by 92% of the passengers carried, and the introduction of this new level as a flat fare with transfer facilities, would enable Glasgow to afford to increase the tramway mileage. The economist said, "the great decentralisation of population effected in the American cities in the regime of the trolley cars was effected in that way. The merchants, professional classes, clerks and better paid mechanics moved into the suburbs, and the houses formerly occupied by them became available for the less well paid merchants and the day labour classes, and afforded them greatly improved housing".

The 1905 Report of the Royal Commission on the means of locomotion and transport in London recommended a large extension to the tramways and introduction of a flat fare in order to spread the population over a wide area where the land was cheaper and the surroundings healthier. Many municipalities however thought differently about extending outside their boundaries as this action would cause people and industries to move out of the town and decrease the rateable value. In Anglo Saxon countries this stage in the development of cities appears to have coincided with a renewal of a romantic attachment to the land. Ebenezer Howard produced his classic work on Garden Cities of Tomorrow in 1898. This made great play with field, hedgerow and woodland and used inter-municipal railways and electric tramways to link together country satellite towns containing 32,000 people with central cities containing 58,000 people.

Real development awaited both legislation and the Great War. The 1909 Housing and Town Planning Act possibly started the ball rolling and enabled development to take place further from the town centres. For the first time general powers existed for the purpose of effecting street improvements without first obtaining special Parliamentary powers for each particular work. Arterial roads and tramway reservations then began to appear in Birmingham, Liverpool and Glasgow.

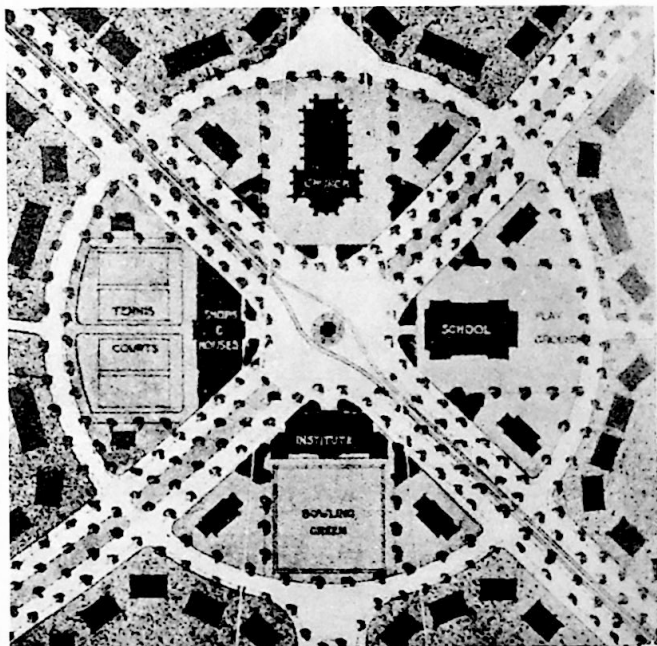


Liverpool - a rapid transit utopia, built only to be destroyed.

The Royal Commission on Housing in Scotland said that tramways were essential to provide cheap and rapid transit to spread the population but that limiting them to 12 miles an hour in the suburbs was quite unacceptable. They concluded that special tracks should be provided along wide roads so that the maximum speed could be raised to 30 miles an hour. City engineers investigating the economics of constructing dual carriageways with reserve track tramways found them very attractive. In 1914 the Chief Engineer of Liverpool pointed out that by cutting all frills he could reduce the comparable cost to a half, though he did warn that this would not be suitable for high speed operation. One particular advantage of reserved tracks in British conditions was of course the elimination of the statutory need for the tramway department to incur paving costs.

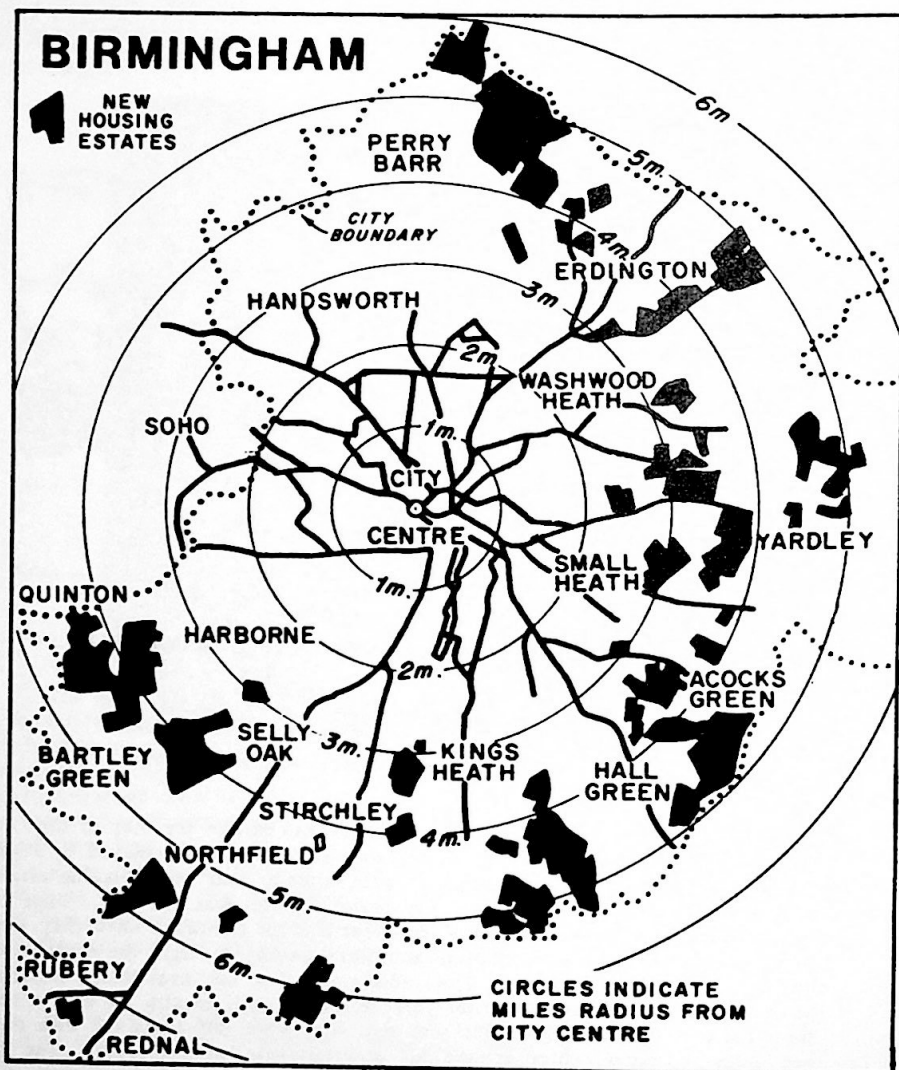
By the end of the Great War it had become apparent that a very large increase in housing was immediately necessary. It was also apparent that private enterprise could not on its own fill the gap, and that municipal building must be encouraged and subsidised. As a result Parliament passed several key items of housing and town planning legislation between 1919 and 1924.

The City Engineer of Dundee was one of many who saw opportunities for creating Utopia. He proposed a semi-circular ring road connected at both ends with the river and extending beyond the city boundary and affording junctions with several radial roads. All these new roads would contain tramways on reservations. Much under-developed land would be brought within easy access of the city and he was at pains to show how town planning and tramways were in perfect unison.



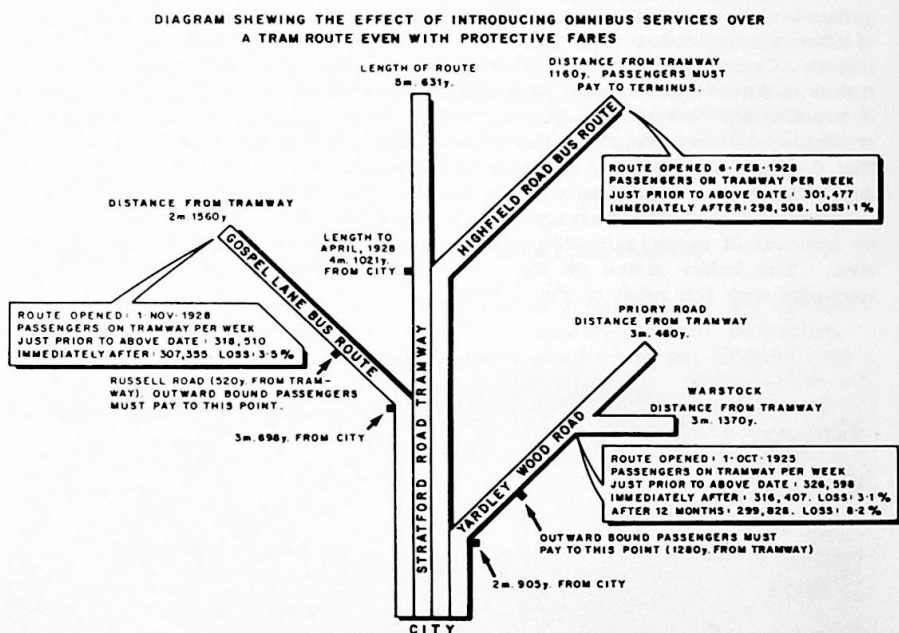
"Dundee of the Future", an unrealised dream of 1919.

Unhappily all of this was not to be. Let us consider the map of the City of Birmingham Housing Estates. This shows what had been achieved by 1932. Those familiar with Birmingham will note already that these housing estates were nearly all served by buses. The reason for this was two fold. First the inflation which followed the end of the Great War hit tramways when they were in a physically run down condition and were having to fight the unrestricted competition of the motorbus. The money was just not available. Equally, however, housing estates were not very desirable goals to aim for with a new tram route. The reason for this was that they were self-contained with their own pubs, cinemas, churches and all entertainment and shopping. The inhabitants were people who were enjoying heavily subsidised housing and had originally lived in the city centre. They were unable to spend much on fares and as a consequence of all the foregoing factors there would be a morning and evening peak and precious little in between. To serve these housing estates



City of Birmingham housing estates and the lack of tramway facilities.  
Source: Tramway & Railway World, 1932.

special bus services were inaugurated, first of all acting as feeders to the tramway. However, pressure from the public for a through seat, which we all know is British phenomena, resulted in competition of the worst kind.



Birmingham housing estate bus services cream off tramway passengers.  
Source: Tramway & Railway World, 1932.

Fig.43

Fig.4.3 shows how the Stratford Road tramway was gradually bled to death by the dispersal of the population and its conveyance on competing and highly unremunerative motorbuses. In the 10 years from 1921 to 1931 the persons per acre in districts such as Ladywood, Balsall Heath, St.Martins and Deritend, St.Bartholomews and Aston decreased by about 10%. Changing patterns of people's travelling habits also resulted in the General Manager, Arthur Baker, lamenting that Birmingham city centre was indeed dead at 7.30 at night whereas previously it had been busy and provided his trams with a good traffic. Mr.Baker sadly foresaw the day where the gradual distribution and thinning out of the population would result in even the finest tramway having to abandon as it would be totally uneconomic to relay routes serving diminished populations.

## Electricity – and the spirit of the age

Our next seed of destruction is psychological. We have come across the Franco-Prussian War before. This event unleashed a flood of utopian stories as thinkers saw the horrors of modern warfare in the midst of Europe and sought more satisfactory ways forward. During the 19th Century inventions appeared to be going forward in a logical fashion, things got bigger, better, faster. The views of Darwin coincided with a belief in the benign evolutionary progression of science. One observer said that science fiction had become the opium of urban masses. Electricity was seen as a mysterious and liberating force of the age. It was Captain Nemo's real power enabling him to roam at will seeking his revenge and it featured in titles such as "The Martyrdom of Man and Electricity". The drawings of Robida and the works of Wells and Verne were widely circulated during this period, coinciding with the spread of popular newspapers and illustrated magazines. The Victorian savage optimism in technological progress was tempered by approval of municipalisation which gave the whole thing the right moral tone. The ladies seated on the balcony of the tramcar were very much in sympathy with this spirit of the times.



At the time of its introduction the electric tramcar held sway over the crown of the road as a result of its demonstrable utility. This gave it the protective weapon of social acceptance.

In 1896 "The Autocar", which was still in its first volume, defended the tramcar against a speech delivered at the Mansion House which held that it could not be considered beautiful. "The Autocar" hoped that the day would not be far away when the motorcar itself would soon possess its accepted lines of beauty. Later in the same year "The Autocar" said "the mechanical tramcar is indissolubly associated with the self-propelled road vehicle. It was, indeed, the precursor of the ordinary type of autocar, and has done more than anything else to facilitate the movement which has grown so rapidly during the past three or four years".

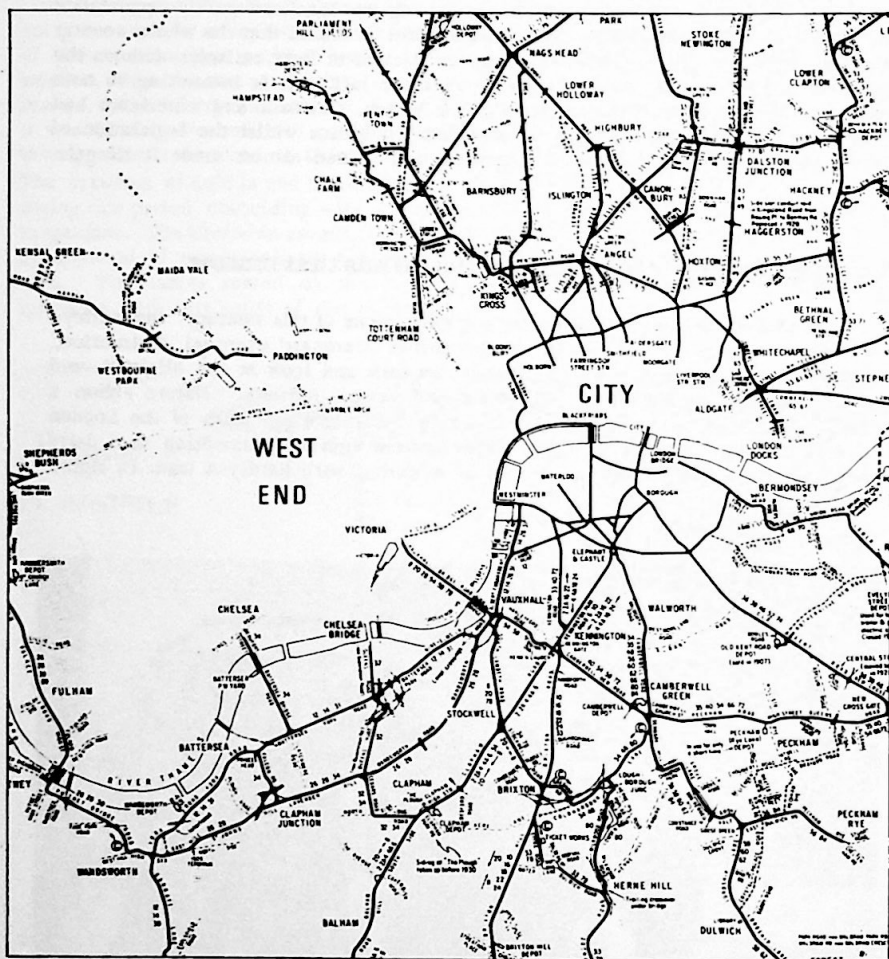
Elsewhere in the same volume of this periodical however, one sees an early warning of future problems. Discussing a fatal accident at the Crystal Palace in August 1896 "The Autocar" editorised "whenever we hear of an accident we debit the pedestrian with the blame until we have proved that it was the driver's fault". They then said, sadly, "sooner or later harsh traffic regulations will be enacted which will be an insufferable annoyance to careful and intelligent drivers". And in the editorial commemorating the legalised public appearance of autocars on British highways "The Autocar" said "it means that the whole country can be threaded with a network of the equivalent of light railways without the need of destroying the roadways with expensive rail". It is interesting to note that the same editorial lamented that the French, Germans and Americans had forged ahead with the creation of motorcar industries whilst the legislation of this country had retarded all development and indeed almost made it illegal.

## Losing the battle to influence the minds that matter

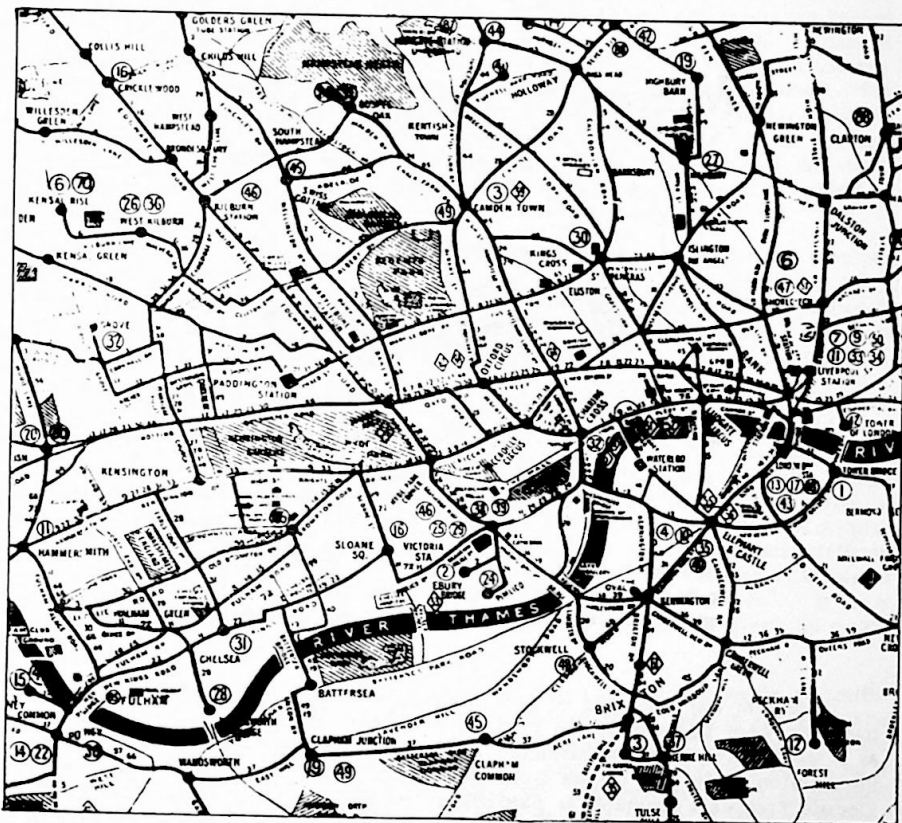
Hindsight now shows that during the early years of this century the embryo motorbus was one of the seeds of the British tramcars' eventual destruction. Consider the map of London Tramway network and look at the blighted void created by the opposition of Parliament and vested interests. Nature abhors a vacuum and this vacuum was soon filled by the motorised buses of the London General Omnibus Company. Our legislators were then soon accepting as a daily normality transport through the streets by motorbus with hardly a tram in sight.



Filling the vacuum in the Capital.



London Tramway Routes and the Blighted Void. The creation of a Vacuum.



The Vacuum is filled with Omnibus routes of the L.G.O.C.

City of Oxford Electric Tramways Ltd.

— ♦ —

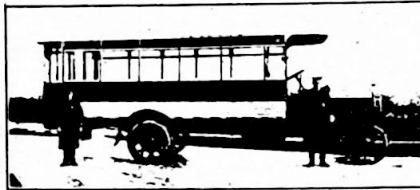
# TIME TABLE

FOR

## Motor Omnibus Services.

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APRIL 3rd, 1914, AND UNTIL FURTHER NOTICE.



Motor Buses for Private Hire for Country Excursions and Outings  
of all kinds can now be obtained.

QUOTATIONS UPON APPLICATION.

The nearest the electric tram got to Oxford. A soon  
to-be-abandoned title, symptom of technological and  
economic change. Social acceptance was ebbing away.

Consider also our seats of high learning, Oxford & Cambridge. Both horse  
tramways were blighted by the motorbus. Oxford was particularly unfortunate  
as it would have been reconstructed as a surface contact tramway but for the  
intervention of leading figures from the motor industry. The City of Oxford  
Electric Tramways timetable is particularly poignant in this respect. The newly  
created company, which had rapidly deserted the mode of transport implied in  
its title, soon changed its name.



## **Another technological revolution and a new public perception**


After the end of the first world war new technical forces, in fact another Schumpeter upturn, attacked the basic premise on which the majority of the tramway mileage of the U.K. had been constructed. The tramcar was not helped by public opinion to adapt to this problem by intelligent evolution. I suggest this was mainly because of a lack of appreciation of the effects of the unrestricted joys of the motorcar and a totally new psychological mood. For these were "modern times". For a twenty year period the electric tramcar had been the wonder of the age, second only to the electric light. It was on the public's acceptance of its utility and modernity that it enjoyed the crown of the road. The changing public psychology withdrew the credibility the tramcar needed to keep its place.

After 1918 destruction seemed to matter more than construction. Fashions in clothes, likes and dislikes, and the way in which the final architectural icing was put on buildings changed with greater rapidity than before. Perhaps trench warfare and the all too apparent effect on it of the petrol engine resulted in the public accepting the constant breaking down of hitherto fixed positions.

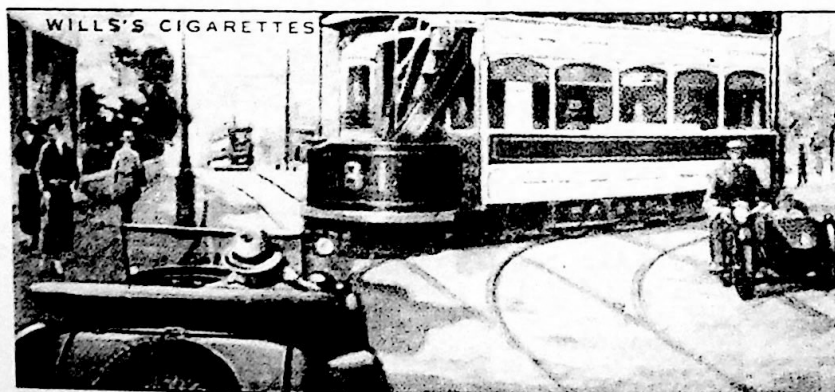
Although this period was dominated by the last child of the third Schumpeter upturn, the motor car, it did not lack contribution from the continued development of the electrical revolution. This was for instance also the era of super power stations and long distance grids. At the end of the war, Lloyd George had made a rash promise to bring back to this country 2,000 miles of military railway from France in order to electrify them to open up the agricultural districts. The "Tramway and Railway World" as late as 1924 was editorialising on the evils of municipalisation which had restricted the number of trams to 12,000 when it should have been 50,000. Within 10 years however, it was editorialising defensively that no town over 140,000 persons had given up tram-cars.

In 1927 the A.A. produced a graph showing a five fold increase of traffic in five years. Although there were still thousands of horses used in daily service on the roads the increase of traffic was mainly motorised. The general public saw the utopia promised by the tramcar, of slum clearance and better rural housing, obtainable only through the motorbus. As well as a long established tramway orientated transport press a new press devoted to the interest of motorised vehicles quickly sprang up. Fig.50 shows the all too easy target which tram-cars made as they wound their way along tracks laid solely to accommodate their own problems and which frequently broke every rule of the newly emerging science of traffic engineering. Trams it seemed could not reach utopia.

# MOSCOW HAS A PLAN

A stylized, high-contrast black and white graphic of a car wheel and axle, positioned in the lower-left corner of the top section.

..but in the rest of the world,  
Mr.Ford had a different one.



BEWARE OF TRAMS SWINGING OUT AT CORNERS

Fig.50

Social non-acceptance.

Electricity may have been cast off like an old glove onto the street but in the home it was the coming thing. At the end of the great war, only about half a million homes were wired for electricity. By 1938 this had risen to 8 million. 60% of the houses then being built were wired with the full compliment of sockets as opposed to just having electric light fittings. What a strange contrast with Russia where scientific socialism's marriage with electricity brought forth totally new tramways but precious little for the home.



Electricity, advancing in the home,  
retreating on the street.



Humbling themselves before the enemy.

In 1924 the "Tramway and Railway World" editorialised on the attitude of the daily press to tramcars under the heading of 'Tramophobia'. This was a problem which was to linger long. In 1937 Sir Malcolm Campbell wrote an article in the "Daily Mail" accusing London Transport of virtually usurping London streets. Nearly ten years previously Sir William Horwood, the Commissioner of the Metropolitan Police Force, speaking at the annual staff dinner of the London General Omnibus Company, had described tramcars as "an anachronism of the streets" and remarked that when he saw the roads blocked with the tramcar "his blood boiled". As a result of this the Home Secretary had to reply to the Municipal Tramways and Transport Association that "he very much regrets the chance remark made upon an informal occasion should have been open to an interpretation which he can assure you does not represent the attitude either of the Commissioner of the Metropolitan Police or of the Home Department towards the tramway undertakings of this country".

All of this was rooted in history, as the following "Table of Co-efficient of Obstruction" shows. This table, reputedly constructed by a committee for the Traffic Branch of the Board of Trade in the first years of the twentieth century, but strenuously denied by that body's Railway Inspectorate, who condemned it, was used regularly by the Commissioner of Police for the Metropolis as a weapon against the Tramways Department of the London County Council,

the Metropolitan Electric Tramways and the smaller municipalities which operated in the Greater London area.

#### THE TABLE

TRADE:	1 horse, fast	3	PASSENGER:	Electric Tramcar	10
	1 horse, slow	7		Bus, Horse	5
	2 horse, fast	4		Bus, Motor	3
	2 horse, slow	10		Cab, Horse	2
	Motor, fast	2		Cab, Motor	1
	Motor, slow	5		Carriage, Horse	2
	No mention of Traction Engines			Carriage, Motor	1

As another manifestation of this attitude the City Council of Coventry in considering their future policy could put forward only one argument in favour of replacing the tramcar. That is, it was a poor advertisement for the hub of the motor industry. Speaking at about the same time in Wolverhampton, Mr. Sidney Guy, the Managing Director of Guy Motors Limited, said that "if tramways were not obsolete then someone should patent a flexible track".

It had now become fashionable to deride the tramcar and so we come to the sad fate of Mr. Walsh. Mr. Walsh had started his working life as a stage coach driver and afterwards became butler to a relative of the promoter of the Isle of Thanet Electric Supply Company. From there on he had become a tram-driver. In 1936 Mr. Walsh was still rising at 5.30 in the morning and putting in a 10 hour day. To the end Mr. Walsh was a staunch supporter of the tram and his way of life. "Trams are the most difficult vehicles in the world to drive" he declared. "Handling a heavy tram downhill is not so simple as it looks. It is the finest training a man can have". "Tramdrivers have to stand all the time, and many a young man crows up with leg trouble. But not me". Mrs. Walsh is quoted as saying "I don't like buses - they smell". Within six months of making this statement, Mr. Walsh's trams were scrapped and he was out of work with only a state pension on which to support his blind wife. The electric revolution which gave mobility to the masses deserted many of the anonymous men who helped create it, and sadly left them fair game for many a journalist's gentle derision.



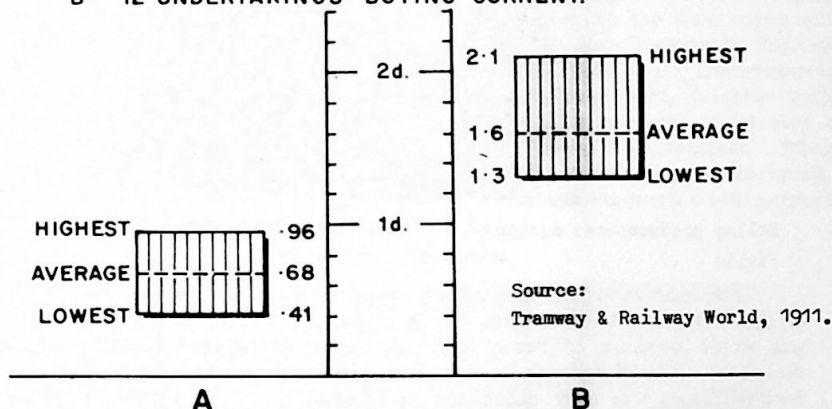
## False beliefs – the cost and availability of fuels

Another seed of the tramcars' eventual destruction was contained in the unprofitable nature of municipalised electric light which for years was hidden by the success of electric tramways. The chart shows how electric tramway companies with their own power stations paid substantially less for their current than those undertakings which had to buy it from a central station. When the tramcar came under attack the electrical industry, with what was obviously indecency and embarrassment, shuffled away from the tramcar which had done so much to support it. But in order to have its cake and eat it, the electrical industry embraced trolley buses.

### COST OF TRACTION CURRENT IN 1911 FOR –

A – 12 UNDERTAKINGS GENERATING THEIR OWN.

B – 12 UNDERTAKINGS BUYING CURRENT.

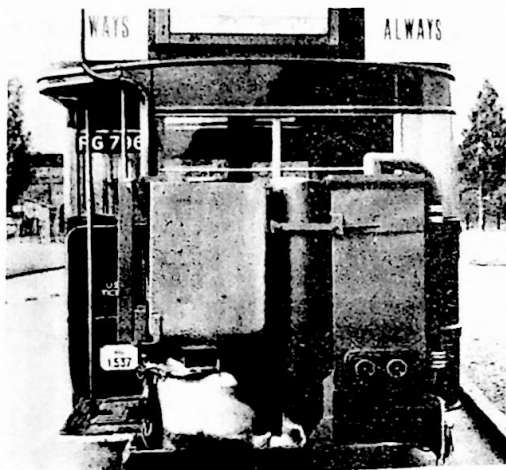


We shall shortly examine the influence of Stuart Pilcher, mainly remembered as the General Manager of Manchester and an active anti-tram theoretician. We come across him now in his justification of Manchester's tram scrapping where he looks at the possible danger of an interruption of oil supplies. He said "with regard to the possibility of a rise in world prices of oil, the opinion of a leading British oil industrialist is that there has never been a time in the history of industry when it was possible to produce so greatly in excess of immediate demands. In contrast to this, the tendency of the coal industry is for the price of coal to rise".

Further words came from the Committee on Imperial Defence which considered that "it is reasonable to assume that a large proportion of the tankers required for our oil imports would escape any attack".

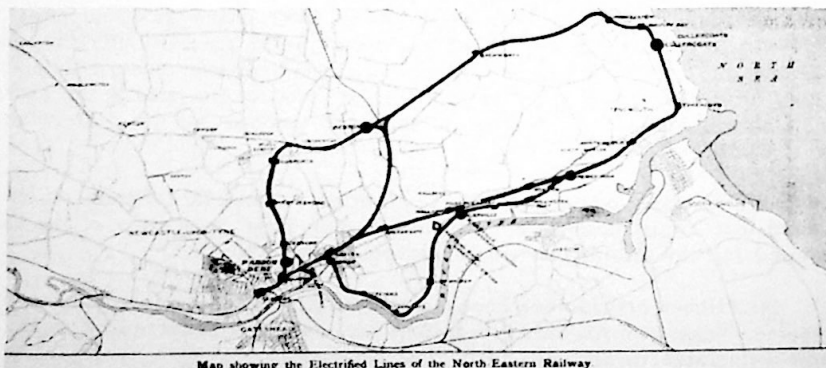
Mr. Pilcher got another knock at electricity when he prayed in aid of the Inspector-General of Air Raid Precautions who considered that trolley buses were more vulnerable to air-raids than motorbuses.

It should not however, be thought that everyone was totally complacent, Fig54 shows one of many experiments covering a wide range of technologies which took place over the 1920's and 30's. Embarrassing parallels can perhaps be drawn between some of these projects and current heavily funded ones taking place in America.



Bellay producer-gas equipment - a Belgian design fitted to a London ST-type double deck bus in 1939.  
Fig.54

The map at Fig.55 may appear familiar as it shows almost the present route of the Tyne and Wear Metro. It is in fact the original electrification which was made because of heavy electric tramcar competition. The system was dieselised in 1967 because its electrical bill was £86,000 a year whereas diesel fuel to run it was only going to cost £40,000 a year. The North-East coast area incidentally, is very interesting from the point of view of the history of electrical supply as it was here that Merz constructed his Neptune Bank Power Station and resulting supply network, which had such an effect on the industry.



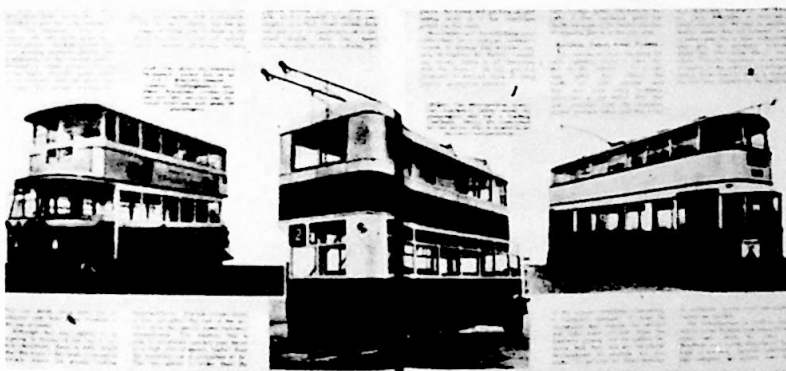
Map showing the Electrified Lines of the North Eastern Railway

With the opening of the Tyne and Wear Metro in 1980, the wheel has now come full circle.  
Fig.55

## The electrical industry's inadequate response to progress

Let us now consider the development of the motor bus after the first world war and some of the reactions of the tramway industry. The war had obviously resulted in the further development of the petrol engine. The motorbus however benefited from two other improvements. One was the introduction of pneumatic tyres which enabled speeds to be increased from 12 to 20 miles an hour and then later, as the speed limit was raised in 1928, to 30 miles an hour. The other was a result of the pre-war government programme to improve the road surface. This resulted in the tarmacadum road.

Unlike the tramway industry there were many bus builders all vying to produce new products in great rapidity. This gave transport managers a continually evolving selection of buses to choose from. As Fig. 56 shows, outwardly at least a number of new tramcars bore similar styling to the new vogue exemplified by buses and trolley buses. Tramway enthusiasts frequently think of vehicles such as the Feltham as the norm for the late 20's and 30's. Unfortunately this was not the case. For every modern car built at Blackpool, Brighton built an open topper. Such modern looking cars as were built were spread over a 30 year period and clustered in tiny ghettos known only to the enthusiast. Their psychological effect on the public was really zero. Perhaps only Blackpool, by having a large proportion of good looking trams and reserved track exposed to holiday makers, achieved any mental impact.



Another negative feature was the primitive technology applied under the cosmetic skin of streamlining. Traditional mechanical and electrical features were topped out with a body built on traditional constructional methods. In 1936, P.J. Robinson, the city electrical engineer of Liverpool, created a furore over his luncheon remarks to the British Electrical Development Association. He said that "they had to blame the 1910 mind of the average tramway manager for the fact that so many of the trams had fallen into disrepute, and they had to compare them with the 1935 minds of the bus people".

## The 1930s and two engineering cultures

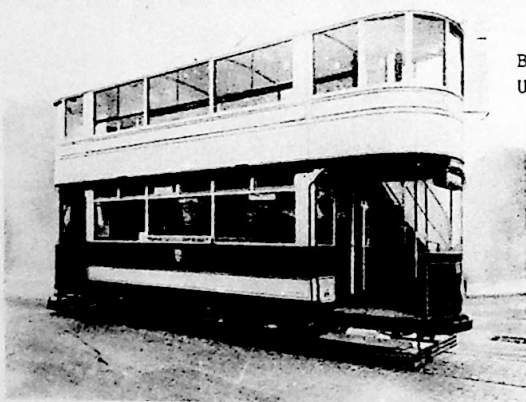
A look at Ilford's 1932 tramcars in my opinion justifies the previous statement. Just look at the caption. "Built with well tried components". The text says that the car is of special interest since it comprises parts and components which for several years the manager had made the subject of investigation. And if the reader has not already fallen to sleep he will read that in the opinion of the management an enclosed car has no advantage for traffic which is purely local.

### New Tramcars at Ilford

*Built by the Brush Company to Mr. L. E. Harvey's Specification of Well-Tried Components.*

The recent additions to the rolling stock of the Ilford Corporation Tramways were constructed to the specification of Mr. L. E. Harvey, the general manager and engineer, and are of especial interest since they comprise parts and components which, for several years, he has made the subject of investigation. Further, besides testing them for the benefit of his own undertaking, Mr. Harvey has from time to time rendered service to managers and engineers generally

by running are well known, and another advance is obtained by the use of Hoffmann roller bearings for the axles. These bearings are also utilized for armatures of the motors which are the British Thomson Houston type of 40 h.p. Long the tracks supplied by the Brush Company are fitted, their adoption being the result of satisfactory operation on other cars over a period of years. Brake shafts are fitted with ball bearings.



British tramcar design..(1).  
Using fossilised technology.

Fig.57

One of the new cars for Ilford Corporation Tramways recently supplied by the Brush Electrical Engineering Co.

by reporting upon the results to the Municipal Tramways and Transport Association.

Delivery of the new vehicles has been completed by the Brush Electrical and Engineering Co. and at

While the upper saloon has fully enclosed ends, the lower saloon has open platforms. It is the opinion of the management that an enclosed platform

Fig.58 shows what was heralded time and time again as Europe's most luxurious public transport vehicle. We now have the advantage of history to look back and compare these vehicles with the PCC's. As many people know PCC's are still running in several parts of the world and even without maintenance giving a very credible account of themselves. Does anybody who has had experience and knowledge of the problems that have been faced at the

National Tramway Museum with "modern" Glasgow vehicles believe that they are of the same world. Frankly I think that we have to accept the fact that, with the PCC, a total new era arrived for tramways and it was as basic as the switch from horse to electricity itself. To continue manufacturing tramcars built on the lines of this Glasgow vehicle after the mid-1930's was, frankly, ludicrous. The British tramcar industry did not deserve to survive.

# The TRANSPORT WORLD

FOUNDED 1892



LONDON, JANUARY 14, 1937

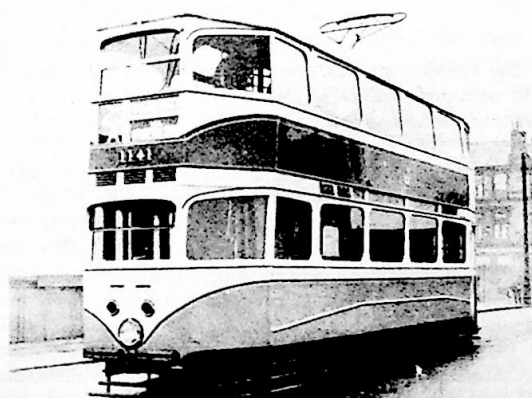
No. 2581 (Vol. LXXXI)

## Glasgow's New Type Tramcar

NOTABLE ADVANCE IN DESIGN AND EQUIPMENT PROPOSAL TO CONSTRUCT A HUNDRED

Glasgow has been well served by its tramways for many years, although no attempt has been made until the present to produce an entirely new type of double-deck car. It was decided some time ago to

construct a notable advance in design and is a complete departure from any at present in service in the city. It is rounded on the sides and shaped windows give an attractive external appearance.



British tramcar design..(2).  
At best just evolutionary.

Fig.58

Glasgow Corporation's Latest Tramcar has Most Streamlined Effect and Windows that Allow Maximum Visibility.

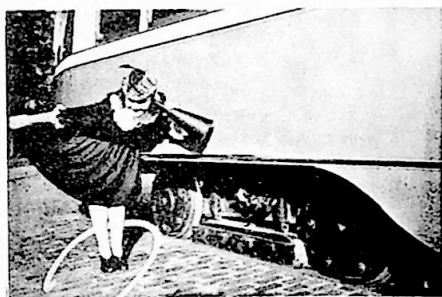
The Corporation's Transport Department has designed and built the car, which is now being tested on the road.

The car, which is now being tested on the road, is a complete departure from any at present in service in the city. It is rounded on the sides and shaped windows give an attractive external appearance.

Let us now take an international yardstick against which to measure the progressive nature or otherwise of the British tramway manager and the industry which was meant to be supporting him. Fig.59 shows one of the early PCC's delivered to Chicago in the mid-1930's. In 1975 the U.S. Department of Transportation became so desperate about the state of the art of transit car building in America that it felt justified in re-issuing certain of the technical papers connected with the development of the PCC. In introducing these papers to the industry the Department said "the history of the development of the PCC car is unique. The committee performed what was probably the first system

engineering design effort in the U.S., referred to at the time as the scientific approach. The design parameters were formulated only after a thorough investigation of all the major existing electric railway vehicles. It was a scientific, dispassionate and unbiased approach. The product of the research programme was a light weight, less expensive, high performance street railway car of superior quality in every respect. The committee pioneered the use of rubber suspension systems, utilised all welded steel body construction, and advanced illumination techniques".

Mass Transportation in America



American tramcar design - The Presidents Conference Committee (PCC) car.

A revolutionary vehicle setting totally new standards in comfort, performance and economics.

Fig.59

The electric railway Presidents who formed the committee had the wit to realise that they needed non-tramway people to carry out the work of the investigation. They were singly fortunate in their choice and particularly in their Chief Engineer, C.F.Hirshfeld. Tramcar operators themselves gave marvellous support, both moral and financial to the work which took several years. The story of the PCC is not of course a subject for inclusion in this booklet although it should be noted that it is a subject of high drama as many companies which were supporting the concept initially went bankrupt during the study. For our purpose however it is most appropriate to note Hershfeld's confidential memorandum, one copy of which has recklessly survived, regarding the attitude of the traditional tramcar industry. In respect of the electrical industry he said that they 'started these conferences with certain definite ideas to which they appeared to have agreed among themselves. The simplest description of the situation is to say that they intended to insist upon return to practically what existed before the committee started its work". Speaking of the car builders such as J.G.Brill, he said "above all, we have shown that the principals of street car design can be rationalised and formulated so that any skilled engineer can design with a reasonable assurance of success. It is not necessary to have access to the carefully guarded secrets of any one or any group of manufacturing. As a matter of fact, it has become apparent that most of these secrets represent, very largely, invitations to continue along the patterns that have led this industry into difficulties".

Having produced prototypes the committee then found that the industry had to be cajoled into manufacturing of production quantities. Hershfeld said that the industry had to stick together and use its buying power as a weapon because "until then the manufacturers may be expected to engage in political manouvres intended to maintain their erstwhile advantage instead of busying themselves with the real problem".

## Stuart Pilcher—a man on the make

Let us now return to Stuart Pilcher. Although in the ultimate he did not cause tramway abandonment, which would have taken place without him anyway, he appeared as the standard bearer to his contemporaries. Stuart Pilcher was the manager who converted Edinburgh from cable to electric after the first world war in a period when, quite frankly, the conversion could have been made to buses in one go. Indeed, the "Manchester Guardian" felt at the time, that is in 1922, that Edinburgh, which had been a laughing stock for putting beauty before efficiency with its cable cars, had suffered enough and that really it should take a leaf out of Oxford's book and go to motorbuses. Reading Stuart Pilcher's technical papers, and indeed the first book he published on transport was heavily weighted towards trams, he seems a competent enough person technically. Indeed in the conversion of Edinburgh he displayed much ingenuity, saved considerable capital by utilising old assets and even experimented with resilient wheels.

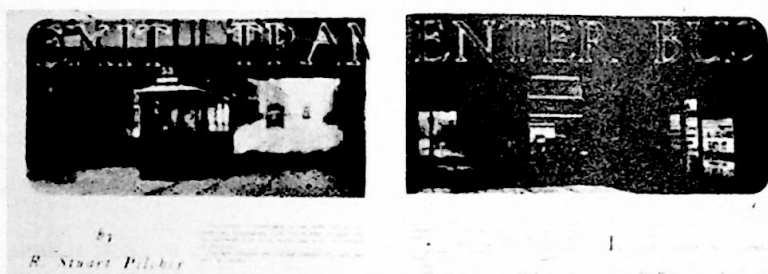
However, this was an era when, if a manager wanted to make a name for himself it was cheaper and quicker to replace old stained glass trams and motorist annoying tracks with modern looking buses. The accounts would show success and the manager would therefore be in favour with the Transport Committee. Indeed tramcar Sinking Funds could be raided for the conversion whereas if the tramway was to be maintained and modernised the Sinking Fund would frequently have been totally inadequate. Also, the manager who scrapped his trams in favour of buses would have had the blessing of the motoring organisations who of course were not trying to do any more at that stage than win the crown of the road belonging to the tram, leaving the bus in the gutter.

Stuart Pilcher seems to have worked on the basis that if you wished to be noticed, and you have managed to get hold of an idea slightly ahead of its time, then you used every platform to pronounce it. For a while people may smile but shortly, as you are proved right, you become a sage. Stuart Pilcher knew very well that modern trams need be no more noisy than a bus and indeed he knew very well, and said so, that modern trams would attract as many passengers as would a modern bus. He is in fact on record as saying that if tramcars were modernised it would be very difficult to scrap trams, and therefore trams should not be modernised because in his opinion as tramways were doomed anyway it was better to get the job over quickly.

I was delighted to find in my researches, that Ian Yearsley, the Editor of "Bus & Coach", had been researching independently into the development of the British tramcar after the first world war and into the works and activities of Stuart Pilcher. I was further delighted on reading his notes to see that he and I had come to the same conclusion. Ian gave many examples of how Stuart Pilcher, although he obviously believed the righteousness of his case, was not

adverse to trimming the facts to suit his presentation. The "Tramway and Railway World" rumbled Pilcher as early as 1930 when it took him to task in a leading article. He had for instance quoted comparable bus and tram fares without mentioning that the bus fares were about to be increased. He had spoken of a great shift of passengers in Manchester from trams to competing buses without mentioning that nearly the entire tram route in question was constructed of worn rail and collapsed foundations. As the "Tramway and Railway World" said there is only one form of transport worse than a broken down tramway and that is the solid tired omnibus.

### Manchester Tram Route 53



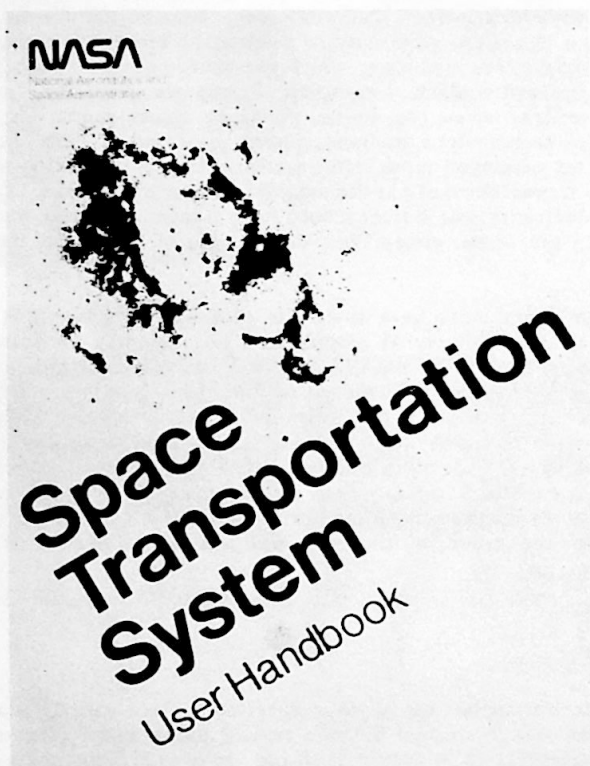
We have already eluded earlier to some of the rather dramatic and misleading references which Stuart Pilcher used in his submissions justifying buses against both trams and trolleybuses. His final edition of "Road Passenger Transport" for instance, included a chapter on tramway abandonment. A third of the fifteen pages of this chapter were concerned with showing how Manchester buses could negotiate fogs as easily as Manchester trams. Perhaps Stuart Pilcher's greatest cue was the dramatic conversion of the number 53 Manchester tram route. This was generally regarded as the first time when a major trunk route had been abandoned and replaced by buses. Not only that, but the results were so tremendously favourable. Operating speeds went up, the number of vehicles needed to run the route decreased, and passengers went up. It is difficult in a way to know whether to criticise Pilcher or not. What had the tramway industry of that date to offer in comparison with the Leyland Titan which was able to slip its two decks under the lowest railway bridge? Of course operating speeds were increased if single track and loops were abandoned. With hindsight we can see that route 53 was an easy victory for the bus. At the same time Stuart Pilcher had got Manchester's Tramway Committee to reconsider their decision of some months standing to extend the tramways to a distant housing estate. In Manchester at least, from now on no tramway was going to utopia.

In the absence of a decent armoury of modern technology the industry took all the wrong lessons from Manchester. A grubby route of single track and

loops, run with broken down California cars, became the yardstick to justify the scrapping of system after system. Pilcher had broken the taboo and whereas previously only minor tramways, which everybody now agreed should never have been built in the first place, were scrapped, the new order was "scrap the lot". Stuart Pilcher was never one to do things by halves and in his report on the conversion of Manchester's tramway system presented in 1938, he showed that the use of oil employed more British workers than the generation of electricity. As a result it was obviously in the national interest to use buses! The unreliable nature of electricity was further rubbed in by Appendices pages long, listing all the faults in the feeder system and the number of times that the trolley pole came off.

Pilcher didn't quite have it all his own way though. It is gratifying to look back and read his verbal clashes with such tramway advocates as Hopkins of Sunderland, Vane Moorland of Leeds and Luff of Blackpool. When Pilcher crossed these gentlemen, his torrent of anti-tram facts was replied to, fact for fact, word for word. The only thing was that their facts showed the reverse situation. Trams were not necessarily inferior to buses in respect of speed, revenue per mile or attractiveness to the public. However as I have already indicated this was the best of yesterday's technology being matched against an evolving technology and playing a battle out on streets where another contender for the crown of the road was waiting to pounce on the new and temporary victor.





## **CHAPTER 6**

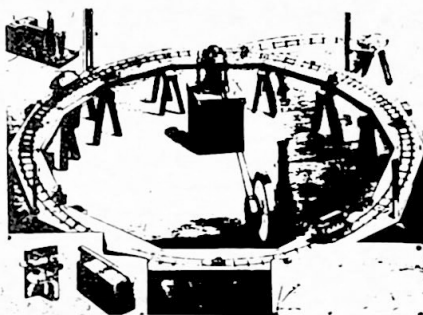
### **TOWARDS THE 21st CENTURY**



#### **THE CONVERGANCE OF COMMUNICATIONS AND DATA PROCESSING**

# Towards the 21st Century

The future of the tram and bus - will they merge?



An experiment ahead of its time - Professors Ayrton and Perry's automatic electric railway of 1881.

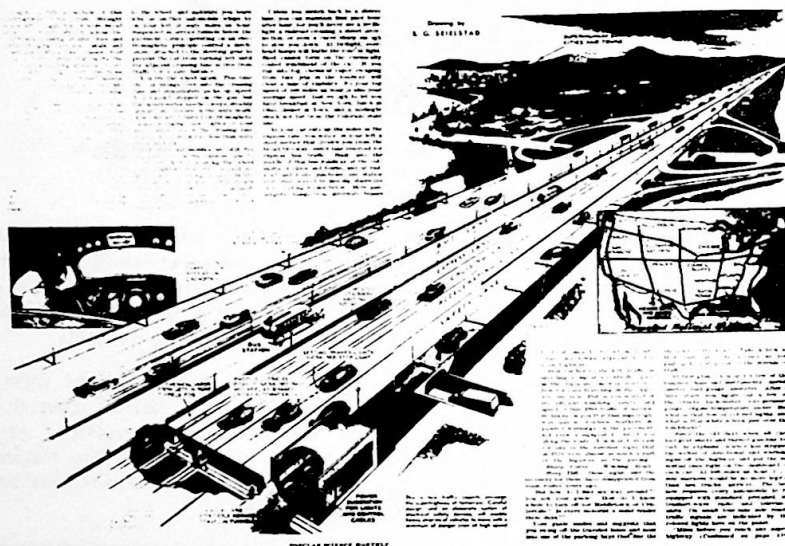
Let us now look to the future. But let us start by considering a tram from the first days of electric traction. In 1882 Siemens exhibited a small automatic electric postal railway at Paris. In this country Professors Ayrton and Perry demonstrated a system of ensuring that electric trains did not run into each other. This system evolved into the "grand-daddy" of surface contact.

A few years ago the idea of automatic railways resurfaced in the form of "Cabtrack". A model layout was used to work out a computerised control. It is significant to note that it was before the days of micro-processors. As an aside I should note that this entire installation was purchased by The National Tramway Museum and is now in storage, though sadly, space limitations have precluded keeping it intact on its baseboards.



From Cabtrack came the "Mini-Tram". The saga of Sheffield's Mini-Tram that never was, is of course, fresh in many peoples' minds, as indeed are the proposals for London, Southampton and many other places. The full size test vehicle was also purchased by The National Tramway Museum. America, Germany and France have spent millions of pounds trying to develop similar systems.

Before dismissing the Mini-Tram as an historical curiosity however, let us consider this American dream of the 1930's. In 1938 the Automobile Club of Southern California published its famous survey and report which gave birth to the concept of urban motorways. "Would the motorway be an architectural eyesore? Definitely not. It is almost an axiom of modern civilisation that man's highest achievements in industrial design are in themselves objects of symmetry and beauty". Well we can all make our minds up about the wisdom of that prophecy, though happily or unhappily the basic policy of the document has come to pass. Fig.64 depicts a variant suggested at the same time. It is in fact a system of automatic roads with automatic bus lanes down the centre. Buried wires tell the driver where he is, alert him to traffic conditions, slow him down and generally take away from him the mobility he thought he had. Almost a Mini-Tram in principle.



A 1938 idea for automatic control of road vehicles on a nationwide scale in the USA.

Fig.64

Currently, a driver guidance and information system is being laid on one hundred kilometers of German road. This will enable 400 selected motorists to tap out their destinations and they will then be automatically directed before every turn-off and exit. They will be told whether to make a detour and what traffic conditions are like. Perhaps as a slightly mischievous technical thought, we can ask ourselves the question "are the tram and bus going to merge as micro-electronics brings into reality the dreams of Siemens of totally automatic transport." ?



## **The future of tramway history- will it assume its rightful place?**

Looking again to the future let us now see the sort of contribution by tramway historians that should be encouraged and the cross-fertilisation that should be sought between people working in different disciplines. An illustration of St. Petersburg tramways showing the development from horse to electric services and the urban growth of the capital is just one of many from James S. Bater's superb book entitled "St. Petersburg Industrialisation and Change". The publisher claims that the book presents for the first time a full analysis based on a commanding study of all available Russian sources of how the process of industrialisation changed the capital city of Russia into a densely packed, problem ridden and turbulent place. The publisher further says that the book pioneers a method of cross sectional analysis that allows a full view to be had of social and environmental diversities of each phase of urban development whilst maintaining an overall perspective of the demographic, technological, administrative, economic and human factors.

Maps are shown of the location of industry at different dates, population growth by area, percentage of wooden houses, commercial activity, state owned and private buildings, the incidence of Asiatic cholera, port traffic, over crowding, journey to work by bankers, goldsmiths and artisans. Throughout, the development of the tramway system is related to the process of change in St. Petersburg. In the conclusion, the miles of tramway track and the journeys per head of population in St. Petersburg are related at different dates to those of other great cities such as Berlin, Toronto or New York. This book then, is a very fine work showing how tramways can be accepted as being important by non-tramway historians and indicating how tramway history can make a valuable and necessary contribution without which the overall picture is incomplete. Mr. Bater's book, at £14.95 is obligatory reading.

Distinctly cheaper and equally an excellent book is Sam Bass Warner's "Street Car Suburbs". This is sub-titled "the progress of growth in Boston 1870 - 1900". The book was originally published by Harvard College in 1962 and is now available in about 5 editions, some paper back, some hard back, some in Dollars and some in Sterling.

The growth of Boston was obviously very different from the growth of St. Petersburg in that ethnic minorities were a more powerful factor and industrialisation was proceeding at a heavier pace. The whole social structure was literally of another world. The book shows very intelligently how the street railway was one vital element in the great melting pot of Boston at the turn of the century. The saddest thing is that "Street Car Suburbs" should have remained pretty well on its own for so long and we can only hope that similar histories will be written on a greater scale in the future.

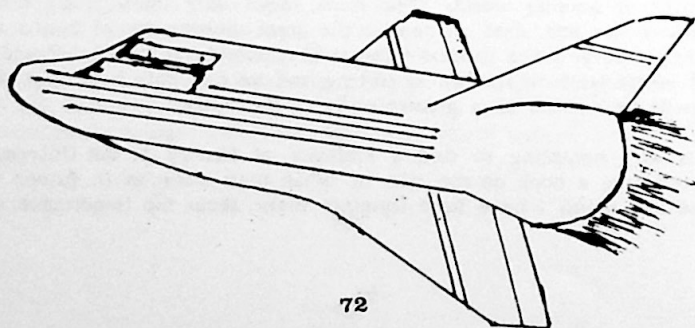
It is also humbling to find a Professor of History at the University of Illinois producing a book on the rise of urban mass transport in Europe which covers the key points I have been trying to make about the importance of the

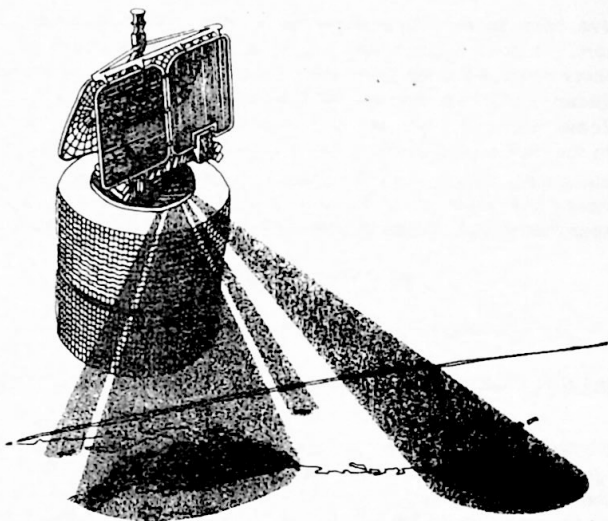
tram car. John P. McKay's book entitled "Tramways and Trolleys" says, "the last years of the 19th century witnessed a profound and many sided transformation; of European urban passenger transportation. Yet, inspite of its obvious importance from many points of view, there is not a single comprehensive study of this transformation and the electric street car revolution which made it possible". Mr. McKay later says "as with transportation history in general, great stress has been placed on purely technical and mechanical details of vehicles and traffic operations in studies of the development of urban passenger transportation. Not that I lack admiration for the expertise of local historians and transit enthusiasts in this area; yet it is clearly time to move beyond the enumeration of equipment and presentation of time tables to broader, less specialised concerns. We need to stress the force of institutions which determined these purely technical developments and analyse consequences and implications of alternative technologies for economy and society". It is humiliating for tramway enthusiasts such as ourselves to find an outsider setting down what should be tackled in our field and then making a very presentable job of it. Indeed not only does his book rely on the Manchester study which I showed you earlier but he has also produced statistics long buried in official archives in Belgium & France. Again I would hardly recommend this book to anybody seriously wondering what direction tramway history should be heading into the 21st century.

### The future - research and the space shuttle

I should like to complete this kaleidoscope of thoughts by returning to where we started, with micro-electronics, and suggesting how they may effect the possibilities for research facilities in the future and the means by which the end product will be communicated to those who are interested.

When we commenced shaking the kaleidoscope we saw how the cost of integrated circuits had declined and we studied their increasing complexity. The number of components on a chip has now risen to a density to which I am sure nearly all of us find impossible to comprehend. However, consider the projection for the next ten years; we are about to hit a million and then go on to 16 million components on a chip. What we have seen up to now has been the creation of very cheap logic. I suggest that what we are about to see is the creation of unlimited and very cheap memory. The combination of cheap memory with cheap logic will overturn our present ideas about television, films and books themselves.





Consider now also the advent of the Space Transportation System. The Space Transportation System is, I suggest, an event of comparable importance to the introduction of the Liverpool/Manchester railway over 150 years ago. By using the Space Shuttle the Space Transportation System will provide regular commercial flights into space and back. Our interest in the Space Transportation System is in the anticipated decrease in cost which will be brought about with respect to satellites. Present technology requires a non-reusable rocket to put a satellite into orbit. The Space Shuttle, with its huge cargo bays, will be able to take several satellites up into orbit at once, and will then come down to earth, to be used again and again.

Our American cousins are already anticipating the coming communications revolution. The major companies such as American Telephone and Telegraph, Xerox and I.B.M. are each proposing satellite based networks providing instantaneous voice and visual communication across the States. A tremendous battle is developing, not only in the U.S. between companies such as we have just seen, but between countries, for a major place in the forthcoming communications revolution. In France for instance the telephone directory is to be done away with during the next decade and replaced by visual display units in each home. These will be provided free of charge by the French Postal Authority and are the first and major step towards giving France the infra-structure appropriate to the next century.

We are all familiar with the hand-held calculator. A similar-looking, but more powerful, device, is the portable terminal. This unit is capable of communicating directly with a computer, via, radio or telephone. The results of this communication are displayed on a small screen at the top of the terminal. Advanced equipment being provided for the American Army shows a soldier a little map of exactly where he is standing. This map is produced as part of the Global Positioning Satellite System of the Americans. A mark-sensing wand can also be used to read information and convey it to the computer automatically.

There have been incredible changes as a result of micro-electronics over the last few years. I do not think that any of us would deny that the possibilities for the next twenty years are even more tremendous. My own conversations with leaders in the industry indicate that portable terminals, certainly with screens the size of a briefcase lid, will become commonplace. There will be little need to have to go to the new British Library, as you will be able to call up the page, the drawing and photograph or any other piece of information you want wherever you are, whenever you wish to. The creation of international communication networks and appropriate data banks by our major libraries will totally revolutionise research.



### **International data networks, where will tramway history be?**

There is however a danger of the world being divided between the information privileged and the information starved. From the tramway historians' point of view there is danger that he will be relegated to the information starved. This is because there is hardly likely to be a rush to put "The Tramway and Railway World" or "Modern Tramway", or the mountain of facts which researchers have accumulated from local newspapers, into data banks.

Governments and giant corporations will create the communications networks. Major libraries and institutions will create incredibly useful data banks as a result of which we shall be able to call up information in our homes from say the Smithsonian or the Science Museum, and manipulate that information by the use of computing power producing graphs from raw statistics. All in the comfort and convenience of wherever we happen to be. However, to participate fully the tramway movement must, in my opinion, give serious consideration to creating its own perhaps modest, but very definitely its own data banks. As many of you are aware, the National Tramway Museum is slowly but nevertheless definitely making progress towards building a library block. At the same time, it is experimenting with today's simple and crude data banks. In this case it is using Prestel. Perhaps the National Tramway Museum will succeed, perhaps it will fail. However, I suggest that its success is important to all who are interested in the future and past of tramways.



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1970. F.E.Wilson Esq. FCIT. FPWI.  
Tramway Permanent Way, with special reference to the LCC Tramways.
1971. C.E.Lee Esq. FCIT.  
Some Tramway Pioneers, Known and Unknown.
1972. C.S.Dunbar Esq. FCIT.  
Fossilised by Statute - Trams and the Law.
1973. A.G.Jenson Esq. MBE. FRIBA.  
Tramway Architecture.
1974. I.A.Yearsley Esq.  
The Next Generation of British Tramways.
1975. J.H.Price Esq.  
The Brush Electrical Engineering Company Limited and its Tramcars.
1976. A.M.Goodwyn Esq.  
The Evolution of the British Electric Tramcar Truck.
1977. G.E.Baddeley Esq. B.Comm. MCIT.  
Tramcar Liveries.
1978. E.R.Oakley Esq.  
The British Horse Tram Era, with special reference to the Metropolis.

